TRAFFIC QUARTERLY

AN INDEPENDENT JOURNAL FOR BETTER TRAFFIC

JULY 1955

Editorial
New York Signal Formula
More Flexible Traffic Control
Retail Structure of Urban Economy
Access Control for our Strangled Highways
Two Regional Centers in One Small Town
An Answer to Multiple Jurisdictions
Los Angeles' Off-Street Parking
Road Signs and Accidents
Law of Retail Gravitation
Bern's Traffic Plans

THE ENO FOUNDATION FOR HIGHWAY TRAFFIC CONTROL

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Editorial

IT IS unfortunate that the President's effort to provide a cross-continental highway system became embroiled in conflicting discussions of ways and means. Means toward attaining a nation-girding system warrant the generous consideration given to past problems of comparable importance.

The present discursive approach to the situation is not unfamiliar. It is to be welcomed as probably the best obtainable, though political or other unrelated considerations will inevitably result in a compromise solution. The idea is basically sound. It looks to the future, and belatedly, to omissions of the past.

Whatever the questions of finance, they do not warrant a continued passive attitude that emphasizes the means rather than their purpose. The need will continue to exist—and grow. Time will not simplify this problem. Only complicate it.

Widely distributed opinions argue no urgent or immediate need exists for a cross-continental highway system. Such conclusions are not substantiated by continuous expert studies. Studies provide convincing proof of highway needs; give reliable information on which to project future trends.

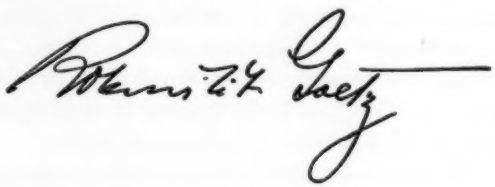
The record of toll roads is enlightening. Toll roads came from a successful effort to meet an inescapable necessity. They have gained public confidence and acceptance—and enlivened the activity for better highways. Toll roads stemmed from private risks, and the pay-stile method of providing needed highways may in time reach fringe areas where the wisdom of investing private funds is not so clearly evident. To this extent, dependence on toll roads does not provide a suitable basis for a planned national highway system.

The public, conscious of its tax load, has demonstrated its desire to pay for better roads. It is sufficiently informed to realize that, in any case, it *must* pay. It is fully aware of the advantages of a planned system. The problem is not simple. *It is highly complex.*

We are free to drive on public highways. But we are not unconscious of their financial origin. With all our tax complexities we realize taxes are the only way to obtain enough good roads. The end toward which the idea aims is clear and timely.

To reach this end fruitfully requires broad technical study bearing on our national welfare, our economic growth, population distribution, and national defense. Our transportation problem is acute. The effect of its muddled confusion has reached almost every individual. Our travel is circuitous, halting, time-consuming and expensive. *These transportation defects we should definitely correct and look to future trends plainly before us.*

Our lives are geared to high mobility. A proper viewpoint of corrective measures should extend to our four boundaries and to contiguous ones. *Without vision, we may curb our mobility and lag far behind our inventive genius.*



Access Control Will Relieve Our Highway Strangulation

CLIFTON W. ENFIELD

Mr. Enfield is an Assistant Attorney General of the State of Oregon and Chief Counsel for the Oregon State Highway Commission. In addition to his legal duties, he also supervises the acquisition of all real property required by the Commission for highway and park purposes, and during the seven years that he has served the Commission as legal counsel, he has been active in the development of access-control laws and practices. Mr. Enfield is a member of the Oregon State Bar Association, The American Bar Association, and the Highway Research Board Committee on Highway Laws. He is secretary of the Legal Affairs Committee of the American Association of State Highway Officials, an advisor to the "Characteristics of Legal Tools" Subcommittee of the National Committee on Urban Transportation, and a director of the American Right of Way Association.

SINCE the turn of the century, as vehicular traffic has increased, the blight of commercial exploitation of areas adjacent to highways, commonly referred to as ribbon development, has spread practically unimpeded along the main traffic arteries of the nation. Service stations, motels, restaurants, drive-in theatres, stores of all types, and other commercial enterprises have multiplied until in extreme cases they stretch in continuous lines along entire sections of highways.

Until recently, criticism of commercial development that solicits its business from the motoring public has been largely directed against unsightliness and the destruction of natural beauty of the rural landscape. Within recent years highway officials, traffic engineers, and safety groups have been concerned with additional undesirable effects of ribbon development that go far beyond mere esthetic considerations.

The continual growth of roadside commercialization that is dependent for its existence upon the patronage of road users necessarily results in ever-increasing entrances to highways. The traffic conflict generated by vehicles entering and leaving highways at pub-

lic road intersections and at approaches to roadside commercial establishments—much of which involve left-turn movements across opposing traffic lanes—together with parking of vehicles upon highway shoulders and increased pedestrian traffic induced by ribbon development, conspire to promote traffic congestion and invariably produce the following results:

1. Hazards to the safety of persons and property traveling upon the highways.

2. Reduced speed zones and signalization of public road intersections and crossings at grade.

3. Decreased vehicle-carrying capacity of highways.

By a brief reflection upon the problem, we can visualize the snowballing effects of uncontrolled access, ribbon development, and intersecting streets. Traffic congestion and safety hazards are created which must necessarily be minimized by signalizing intersections and by establishing reduced speed zones. These measures result in decreased average speeds of vehicles and require greater travel time, all of which reduce the vehicle-carrying capacity of highways and diminish benefits to motorists from the public highway investment. Not only is there impairment of the public investment, but substantial additional costs are imposed upon motorists and commercial haulers because of increased depreciation and operational costs that necessarily result from increased travel time, frequent acceleration and deceleration of vehicles, starting and stopping at signalized intersections, to say nothing of the mental and nervous strain imposed upon drivers and passengers.[1]

Growth of the Problem

An objective analysis of this vital highway problem will pinpoint the principal contributing cause as being uncontrolled access to highways from abutting property and intersecting roads and streets, with signalized intersections being a measurable limitation on the vehicle-carrying capacity of highways.

To understand and solve the highway problem created by uncontrolled access, it is desirable to know something about access,

1 See Gibbons and Proctor, *Economic Costs of Traffic Congestion*, Highway Research Board Bulletin No. 86 (1954).

what it is, and how it originated. From a study of early court decisions, we find that what is now known as "right of access" was a product of the American courts subsequent to the Revolutionary War. In colonial times land in America was largely unsettled. When needs arose for the construction of roads, land for right-of-way and road-building materials were taken generally without compensation and without judicial process, and in the circumstances none was necessary.

As the country was settled and land became more valuable, the requirement that compensation be paid for private property acquired for public purposes became generally recognized, and protection of individual property rights is now embraced by the Constitution of the United States and the constitutions of all the states.

The first American case to intimate that a property owner might have a property interest in an adjacent street was decided in Kentucky in 1838.[2] Following development of the steam engine and use of electrical power, courts were required to determine if the construction and erection upon streets of railroad tracks, elevated railways, and other facilities that interfered with the access of abutting property required the payment of compensation to abutting property owners. In these early cases, the courts generally held that where the public had only an easement for street purposes and the abutting property owner had fee title to the land in the street the placing of steam railroad tracks or other facilities thereon, which were not proper street uses and interfered with access to the abutting property, constituted an additional servitude upon the abutting owner's fee title to the street and required payment of compensation to the abutting owner.[3]

However, where the abutting owner did not own fee title to the

[2] Lexington & Ohio R. Co. v. Applegate, 8 Dana 289 (Ky. 1839). The court stated, at page 293: "The streets of Louisville were designated, not only for subserving the public purposes for which the town was established by law, but also for the especial convenience and enjoyment of such persons as should purchase and hold lots contiguous to them. The title to such lots carries with it, as essential incidents, certain services and easements, not only valuable and almost indispensable, but as inviolable as the property in the lots themselves. And, therefore, the owners and occupants of houses and lots on Main Street, between Sixth and Thirteenth, have a peculiar interest in that street, which neither the local nor general public can pretend to claim—a private right in the nature of an incorporal hereditament, legally attached to their contiguous ground . . ." This language, although not necessary to the decision reached by the court, was later relied on in other jurisdictions; *e.g.*, Crawford v. Village of Delaware, 7 Ohio St. Rep. 459 (1857); Cincinnati St. Ry. v. Cumminsville, 14 Ohio St. Rep. 524 (1863).

[3] 18 Am. Jur., Eminent Domain, § 190; 5 Nichols, Eminent Domain §§ 10.31 to 10.31[5] (3rd Ed. 1950).

street, many early court decisions held that he was not entitled to compensation for the obstruction of access. Although the failure to allow compensation in many of these cases was based upon the courts' finding that the offending facility was a proper street use, many courts distinguished between an abutting owner who owned the underlying fee in a street and one who did not, which consideration undoubtedly influenced the courts' decisions.[4]

Obviously, inequities would result if compensation were dependent upon ownership of title to land upon which a street is constructed, for an abutting owner may suffer substantial damages by obstruction of access irrespective of the title to the street area. The case that lead to abolishing the distinction of ownership was *Story v. New York Elevated R. Co.*, 90 N.Y. 122, (1882), which was followed by a series of cases in New York holding that an abutting owner has a right of access to go to and from his property and an adjacent public street, and that any material interference by a nonstreet use with such right of access is a taking of private property requiring the payment of compensation.[5]

The Supreme Court of Colorado, in 1883, not only declared the existence of a right of the abutting owner in a street owned in fee by the city but described the right as an easement, in the following language:

> "The abutting lot owner has a peculiar interest in the street. He has rights therein, not shared by the general public. If the fee thereof be in the municipality, he owns an easement therein."[6]

Thus, the courts by judicial decision created a private right in public land, and thereby produced a strange result. When a public body acquires fee title to property and constructs a public highway thereover, there springs into being rights of access that are appurtenant to abutting property; whereas no such right is created when fee title to land is acquired by an individual or by the public for other than public road purposes.

It was probably a natural product of the requirements of colonial

[4] *E.g.*, Moses v. Pitt. Ft. W. & C.R.R., 21 Ill. 515 (1859); Clinton v. Cedar Rapids & M.R.R., 24 Iowa 455 (1868); Atch. & Nebr. R.R. v. Garside, 10 Kan. 552 (1873); People v. Kerr, 27 N.Y. 188 (1863).

[5] *E.g.*, Bohm v. Metropolitan Elev. R.R., 129 N.Y. 576, 29 N.E. 802 (1892); Kane v. New York Elev. R.R., 125 N.Y. 165, 26 N.E. 278 (1891); Lohr v. Metropolitan Elev. R.R., 104 N.Y. 268, 10 N.E. 528 (1887).

[6] City of Denver v. Bayer, 7 Colo. 113, 2 Pac. 6 (1883).

days that the courts created this private right in public roads, for travel was slow and limited to that by foot, horseback, and horse-drawn vehicles; and the early primary purposes of roads were to afford farmers and ranchers a means of access to town and market and to link together the small communities that were springing up in this country. Furthermore, abutting land owners usually donated land for right-of-way and road-building materials and assisted in constructing early roads; in essence, they had a proprietary interest in the roads. The early roads that gave rise to the courts' creation of rights of access were land service roads in all respects. That the law is a natural product of the times is founded in history and has been commented upon by Justice Holmes, as follows:

"The life of the law has not been logic: it has been experience. The felt necessities of the time, the prevalent moral and political theories, intuitions of public policy, avowed or unconscious, even the prejudices which judges share with their fellow-men, have had a good deal more to do than the syllogism in determining the rules by which men should be governed."[7]

The automobile, however, has in half a century wrought a complete change in highway design, standards, requirements, and financing. As motor vehicles came into common use the transportation picture in this country began changing. Within a decade, trips of 100 miles or more became as common as trips of five or ten miles, and average speeds of from three to five miles an hour jumped to 20 and 30 miles an hour. The pressing need for better roads to meet the requirements of the automobile, particularly in providing paved roads, resulted in the enactment of the Federal Highway Act in 1916, and a nationwide system of highways was launched. The court-created right of access, with its resultant ribbon development, the ingenuity and inventiveness of automobile manufacturers, and the demands of the public for better roads, all of which have outdistanced highway construction, have brought the nation to its present condition of traffic congestion and highway deficiencies.

Right of access to an existing highway is a vested property interest that is appurtenant to abutting property, the taking of which requires payment of just compensation.[8] A different situation exists,

[7] Holmes, Common Law 1 (Little, Brown Co., 1948).

[8] 18 Am. Jur., Eminent Domain, § 158; 29 C.J.S., Eminent Domain, § 105; 2 Nichols, Eminent Domain § 5.72 (1).

however, when an access-controlled highway is to be constructed upon new right-of-way where no highway previously existed. The denial of access to such future highway has been held by the highest court of two states not to be a "taking" of property *per se* for which compensation must be paid, for there is no existing vested right of access.[9] In determining if the taking or denial of access is compensable five possible situations may exist, as illustrated in Figure 1.

COMPENSABILITY OF ACCESS CONTROL

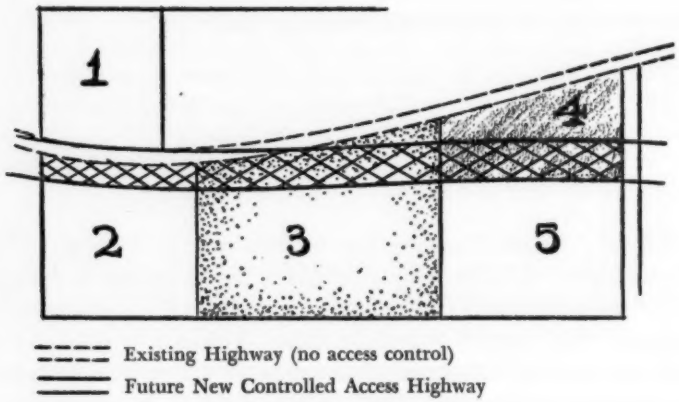


FIGURE 1

In the preceding illustration, Tract 1 abuts upon an existing highway and the taking of vested rights of access require payment of compensation.

Tract 2 abuts upon an existing highway, and taking of rights of access requires payment of compensation in addition to the new right-of-way required.

Tract 3 does not now have right of access to the future new highway for which right-of-way is required, and the denial of access to the future new highway *per se* is not compensable. The controlled-access characteristic of the new highway, however, is a proper con-

[9] Schnider v. State, 38 Cal. 2d 439, 241 P. 2d 1 (1952); State v. Burk, 200 Ore. 211, 265 P. 2d 783 (1954).

sideration in determining severance damages to the remaining property, all of which previously had access to the existing highway.

Tract 4 will continue to have access to the existing highway, and denial of access to the future new highway does not require payment of compensation in addition to payment for the right-of-way required.

Tract 5 does not now have access to the future new highway, and denial of access thereto does not require payment of compensation.

Solving the Access Problem

It is to preserve highway benefits that should be enjoyed by the motoring public for years to come, and to prevent highways from becoming untimely obsolete because of factors not inherent in the highways, that make control of access not only desirable but essential. Access control is recognized as a requisite of modern highways by at least thirty-seven states that are now legally empowered to construct access-controlled highways.[10]

The legal tools necessary for access control may come from the state constitution, statutes, court decisions, or a combination thereof. If state statutes are the source, it is desirable that the legislature clearly express the authority to do all things necessary for the establishment and construction of access-controlled highways.

Access-controlled highways other than toll roads are comparatively new, with national interest being aroused only during the last decade. There is no fountain of knowledge and information pertaining to the subject, and access control experience of the several states span but a few years. Departure from traditional concepts of freedom of access to highways has already given rise to a number of judicial decisions, and the many facets of access control will undoubtedly be a fruitful source of litigation for years to come. The ultimate molding of access-control laws, both statutory and common, must necessarily await the enlightenment of public opinion that will be reflected in legislative enactments and judicial decisions. Highway

[10] Ark., Cal., Col., Conn., Del. (approaches to Delaware River Bridge only); Fla., Ga., Ill., Ind., Kan., Ky., La., Me., Md., Mass., Mich., Minn., Miss., Mo., Neb., N.H., N.J., N.Y., N.C., Ohio, Okla., Ore., Pa., R.I., S.D., Tex., Utah, Va., Wash., W.Va., Wis., Wyo. (Minnesota is authorized to control access by state supreme court decision, Missouri by state constitutional provision, and the remaining thirty-five states by special legislative enactment.)

authorities and other groups can play an important part in this evolutionary process by informing the public of the purposes and benefits of access control, by carefully drafting proposed access control legislation, and by seeking favorable judicial decisions.

Several states are engaged in highway access-control programs; however, there is little published information concerning their procedures, practices, and experiences. Access-control laws differ and the extent and type of access control vary among the several states, but all access control is based upon the same fundamental legal principles. The Oregon State Highway Department has over a period of years evolved one solution to the highway problem created by uncontrolled access, and it may be of assistance to others engaged in this same endeavor to review briefly the practices and experiences of Oregon.

Prior to enactment of any statutes authorizing the acquisition of access rights, the Oregon State Highway Department in 1937 commenced an access-control program limited to a few specific sections of highways and entirely dependent upon abutting property owners' willingness to convey or waive rights of access. This program was reasonably successful and laid the foundation for subsequent statutory enactments.

Statutory Development in Oregon

The first access control statute in Oregon, enacted in 1939, was exceedingly brief and merely authorized the highway commission to acquire all rights of access from abutting property in connection with the acquisition of land for right-of-way purposes. The implementation of this law was delayed by inactivity in highway construction during World War II.

Development of a comprehensive program for establishing and constructing access-controlled highways awaited enactment of the "Throughway Law" in 1947. This law embodies a clear statement of the policy and purpose of the legislature to provide access-controlled highways and contains legal tools that were not previously available to the commission. It is similar in substance to statutes of many other states and authorizes the commission to locate, establish, construct and maintain throughways, to which the owners of abut-

ting land have no access or only limited easements of access, light, air, or view.

To facilitate accomplishment of the purposes of the act, the Throughway Law expressly authorizes the commission to acquire by agreement or eminent domain easements of air, view, light and access, to acquire entire tracts of land even though it all is not immediately needed for public purposes, to construct median dividers or otherwise separate traffic lanes, to close streets or roads where the same intersect a throughway or to carry the same over or under a throughway with approval of local authorities, and to enter into cooperative agreements with the Federal Government and any county or city. The law further prohibits the connection of any future road or street to a throughway without consent of the commission.

Oregon's Throughway Law contains the fundamental requisites for the establishment and construction of access-controlled highways; however, it also contains limitations and mandates which do not always best serve the public interest. Any new highway or relocated section of an existing highway can be constructed as a throughway; however, only those sections of existing highways that have less than ten commercial businesses abutting thereon catering to the motoring public in any one mile can be converted into a throughway. Whether or not a particular business caters to the motoring public is often difficult to determine and of course can be the subject of litigation.

The commission is also required to construct and maintain utility or service roads to serve properties abutting upon existing highways converted into throughways, if such properties are dependent upon the existing highways for access. It would be more in the public interest for the commission to have authority to pay the severance damages actually suffered by the abutting property rather than to construct a costly service road when the cost of construction exceeds the severance damages.

Although the mere designation of a new and unconstructed highway as a throughway would probably deny future rights of access from abutting property to the highway under provisions of the Throughway Law, the Oregon legislature in 1951 enacted an additional law that is applicable to all highways, whether designated as throughways or not. This expressly provides that no rights of

access will accrue to any property abutting upon any portion of a state highway constructed upon right-of-way no part of the width of which was acquired prior to the act. This statute, enacted pursuant to the police power of the state, requires no payment of compensation to abutting owners and recognizes that there is no common law right of access to a nonexistent highway, and it further prevents common law rights of access from coming into existence, which would otherwise occur when the highway is constructed and opened to public travel.

Even though rights of access to a new highway are prohibited by the aforementioned statutes, it is the practice of Oregon to expressly provide in all deeds and eminent domain proceedings that there shall be no rights of access, or only such rights as are specifically reserved, rather than relying upon the statutes alone. This precaution has been taken in light of the possible, but improbable, repeal of the access-control laws by the legislature or a judicial determination that all or parts of the access-control statutes are unconstitutional. In either of these events, without a conveyance or waiver of rights of access, such rights might spring into existence to all highways that are now access controlled.

Use-Control of Access

Highways may be constructed with either full or partial control of access.[11] Where there is only partial control, the access reserved for service of abutting property is usually controlled by limiting the number of approaches to the highway and by specifying their location, dimension, and design. Oregon has pioneered in one additional control, the use of access, which restricts the kind or purpose of use that can be made of an approach to a highway.[12] The number of vehicular movements in and out of an approach has a direct relation-

11 Definitions adopted by the American Association of State Highway Officials: "Full control of access means that the authority to control access is exercised to give preference to through-traffic by providing access connections with selected public roads only, and by prohibiting crossings at grade or direct private driveway connections"; and "Partial control of access means that the authority to control access is exercised to give preference to through traffic to a degree that, in addition to access connections with selected public roads, there may be some crossings at grade and some private driveway connections."

12 See Enfield and McLean, *Controlling the Use of Access*, Highway Research Board Bulletin No. 101 (1955).

ship to the kind or purpose of use that is made of the approach; therefore, controlling the kind or purpose of use effectively controls the frequency of use. Use-control can thus be employed to limit the incident of exposure to possible accidents, thereby minimizing traffic hazards and promoting the unimpeded movement of highway traffic.

Oregon has found that use-control is economically desirable because of the flexibility it provides an access-control program, where degrees of restriction of access are possible between unrestricted access on the one hand and complete prohibition of access on the other. Highway authorities need restrict access only to that extent necessary to meet the requirements of the particular highway and at the same time promote maximum use and development of abutting property that is consistent with the paramount highway requirements.

In Oregon this practice results in substantial savings where compensation must be paid for restricting access or where the access control characteristic of a new highway has a bearing upon severance damages to the remaining property of an owner from whom right-of-way is required. For partial restriction of access invariably causes less compensable damage to abutting property than does complete restriction.

Controlling the use of access necessitates enforcement of access provisions to prevent unauthorized use of reserved access. Access use violations conceivably might create substantial hazards to the motoring public and require immediate stoppage that cannot await court action. Furthermore, if the state's sole remedy is injunctive relief, not only may considerable time be required to stop violations, but foreseeably, as the number of reserved accesses increase over the years, violations might assume such magnitude as to make it impractical to seek relief in court in each instance.

This anticipated need for a self-help remedy that can be immediately employed by the state has lead to the practice of providing in deeds and eminent domain proceedings that the abutting owner's right to use any reserved access for all purposes shall be automatically suspended in the event of violation of the access use provisions. This suspension shall terminate and the owner's right to use the access shall be restored when the state is assured that the access will be used only for authorized purposes. Oregon, however, has experienced

very few access use violations, and since introduction of a self-help provision in 1952 it has been employed for enforcement of use-control only once.

Through the process of trial and error, Oregon has developed standard access provisions that are used in options and deeds and, with minor modification, in condemnation proceedings, as follows:

"As a part of the consideration hereinabove stated, there is also bargained, sold, conveyed and relinquished to the grantee all existing, future, or potential common law or statutory easements of access between the right of way of the public way identified as the _____ Highway _____ and all of the grantor's remaining real property consisting of all parcels contiguous one to another, whether acquired by separate conveyances or otherwise, all of which parcels either adjoin the real property conveyed by this instrument, or are connected thereto by other parcels owned by grantors.

CROSSING FOR FARM PURPOSES. "Reserving, so long as any portions of the said remaining property on both sides of the said highway and served by such crossing are held by a single ownership, the right to establish, maintain and use a crossing of a width of _____ feet at Highway Engineer's Station _____ for farm purposes only. The construction of a frontage road or roads shall not defeat the right of crossing.

RIGHT OF ACCESS. "Reserving, for service of the said remaining property, right of access from grantor's remaining property to said highway of a width of twenty-five (25) _____ feet at each of the following places and for the following purposes only:

Hwy. Engr's Sta.	Side of Hwy.	Purpose[13]

SUSPENSION OF ACCESS. "If, after written notice to desist, the grantors, or any person holding under them, shall use any of said rights of access, including crossings, for any purpose not stated for that particular place, or shall permit or suffer any person to do so, such right of access shall automatically be suspended. The grantee shall thereupon have the right to close such place of access for all purposes. The suspension shall terminate when satisfactory assurance has been furnished the grantee that the place of access will be used only for the purpose hereinabove stated; provided, how-

[13] The purposes for which reserved rights of access may be used are set forth in language that is standard in form and consists of one or more of the following purposes: 1. Private residential use only. 2. Production and transportation to market of farm products of the grantor's remaining land only. 3. Development, harvesting and transportation to market of forest products of the grantor's remaining land only. 4. Operation of existing _____ activity on the grantor's remaining land only. 5. Operation of future _____ activity on the grantor's remaining land only. 6. Unrestricted.

ever, that the grantee may first require a bond with sureties satisfactory to the grantee in an amount not in excess of $1,000, conditioned upon faithful compliance with the above provisions concerning the use of access at said place. The grantee's rights to close such place of access and require a bond shall be continuing as to each succeeding use for a purpose not herein stated.

FUTURE FRONTAGE ROAD. "Grantee has the right to build at any future time a frontage road or roads within the boundaries of any present or hereafter acquired right of way; whereupon, all rights of access hereinabove reserved to and from the highway that are on or adjacent to any such frontage road or roads shall cease, but the grantors, their heirs and assigns, shall have access to the frontage road or roads. Said frontage road or roads shall be connected to the main highway, or to other public ways, only at such places as the grantee may select.

PRESENT FRONTAGE ROAD. "Grantee shall build a frontage road within the boundaries of any present or hereafter acquired right of way on the _____ side _____ of the highway, and the grantors, their heirs and assigns, shall have access to the frontage road or roads. Said frontage road or roads shall be connected to the main highway, or to other public ways, only at such places as the grantee may select."

These access provisions will undoubtedly require additional changes and modifications from time to time, occasioned by new experiences, court decisions, and new ideas in devising better highway facilities, both physical and legal in nature, in our changing and, we hope, progressing world. They reflect Oregon's eighteen years of experience in access control, which since 1947 has resulted in contracting for the construction of 649 miles of access-controlled highways at a total cost of $85,237,600 of which $12,622,800 is right-of-way cost and $72,614,800 is construction cost.

Essential Legal Authority

Based upon experiences of the several states and Oregon in particular, the legislative authority desirable or essential for the establishment, construction, and operation of access-controlled highways may be summarized as follows:

1. A clear legislative statement of policy to guide highway authorities and to aid courts in interpreting statutes.[14]

[14] Fla. Stat. § 348.01 (1953); Ore. Rev. Stat. § 374.005 (1953).

2. Definitions of new words and terms if they are not in common usage and are not clearly defined by other statutes or judicial decisions.[15]

3. Authority to locate, relocate, adopt, establish, construct, designate, maintain, and operate access-controlled highways, including the conversion of existing highways into access-controlled facilities. This should include authority to determine the location of highways, both within and without incorporated cities, the width of rights-of-way necessary for present and future construction, the design and construction of grade separation structures, interchanges, frontage roads, connecting roads, traffic channelization facilities, and dividers to separate traffic lanes.[16]

4. Authority to regulate traffic by signs, markers, and stripes, to control parking and speeds, to establish one-way streets and no passing zones, and to prohibit U-turns, left-turns, and other undesirable vehicle movements.[17]

5. Authority to acquire by purchase or right of eminent domain fee title to or any interest in real property, including rights of access, air, view, and light, which in the judgment of the highway authority is necessary for public purposes, with such determination of necessity being conclusive in the absence of fraud or capricious or arbitrary action.[18]

6. Rights of access from abutting property to future new or relocated access-controlled highways should be prevented from coming into being.[19]

7. Authority to provide access, restricted to number, location, design, construction, and use, from abutting property to access-con-

[15] Cal. Sts. & H. Code Ann. § 23.5 (Deering, 1953); Fla. Stat. § 348.02 (1953); Ill. Ann. Stat. c. 121, § 334 (Smith-Hurd, supp. 1954); Mass. Ann. Laws, c. 81, § 7C (1953); N. J. Stat. Ann. tit. 27 c. 7A, § 1 (1953); Ohio Rev. Code Serv. § 5511.02 (Baldwin, 1954); Ore. Rev. Stat. § 374.010 (1953); Pa. Stat. Ann. tit. 36, § 2391.1 (Purdon, supp. 1954).

[16] Cal. Sts. & H. Code Ann. §§ 100.1, 941.1 (Deering, 1953); Fla. Stat. §§ 348.02 to 348.05 (1953); Ill. Ann. Stat. c. 121, § 335 (Smith-Hurd, supp. 1954); Ohio Rev. Code Serv. § 5511.02 (Baldwin, 1954); Ore. Rev. Stat. §§ 366.315, 374.015, 374.030(1), 374.060, 374.065 (1953); Pa. Stat. Ann. tit. 36, §§ 2391.2, 2391.4 (Purdon, supp. 1954).

[17] Fla. Stat. § 348.09 (1953); Ore. Rev. Stat. §§ 374.030(1), 483.040, 483.043, 483.108, 483.346 (1953); Pa. Stat. Ann. tit. 36, § 2391.9 (Purdon, supp. 1954).

[18] Fla. Stat. § 348.05 (1953); Ill. Ann. Stat. c. 121, § 337 (Smith-Hurd, supp. 1954); Mass. Ann. Laws c. 81, § 7C (1953); N. J. Stat. Ann. tit. 27, c. 7A, § 5 (1953); Ohio Rev. Code Serv. §5511.02 (Baldwin, 1954); Ore. Rev. Stat. §§ 366.360,366.370(2), 374.035 (1953).

[19] Ore. Rev. Stat. § 374.405 (1953). See note 14 *supra*.

trolled highways which in the judgment of the highway authority is in the best public interest.[20]

8. Prohibit the construction, erection or installation of anything upon highway rights of way without permission of the highway authority.[21]

9. Prohibit all advertising upon highway rights of way both within and without incorporated cities.[22] (The movement of vehicles to and from the traveled way in connection with the construction, maintenance, and service of signs may cause substantial hazard to motorists and frustrate the purposes of access control, irrespective of the many other objections to use of public rights of way for private advertising purposes.)

10. Authority to close, separate, or relocate intersecting streets and roads, and prohibit the connecting of new streets and roads to access-controlled highways unless consent of the highway authority is obtained.[23]

11. Authority for cooperative agreements between the state and the Federal government, counties, cities, and other subdivisions of the state in connection with the establishment and construction of access-controlled highways.[24]

12. Authority to enforce access restrictions, which may include one or more of the following remedies:

a. Prosecution of court proceedings to enjoin unauthorized access.

b. Suspension of an abutting property owner's right to use an access and closure of the same for all purposes, in the event of viola-

[20] Fla. Stat. § 348.04 (1953); Ill. Stat. Ann. c. 121, §§ 336, 337 (Smith-Hurd, supp. 1954); N. J. Stat. Ann. tit. 27, c. 7A, § 3 (1953); Ore. Rev. Stat. §§ 374.030(2), 374.410 (1953); Pa. Stat. Ann. tit. 36, § 2391.9 (Purdon, supp. 1954).

[21] Mass. Ann. Laws c. 81, § 21 (supp. 1954); Ore. Rev. Stat. §§ 374.305 to 374.325 (1953); Pa. Stat. Ann. tit. 36, § 670–411 (Purdon, supp. 1954).

[22] Cal. Bus. & Prof. Code Ann. § 5287 (Deering, 1951); Fla. Stat. § 479.12 (1953); Ill. Stat. Ann. c. 121, § 160 (Smith-Hurd, supp. 1954); Mass. Ann. Laws c. 93, §§ 29 to 33 (supp. 1954); Ore. Rev. Stat. §§ 377.340, 483.138 (1953); Pa. Stat. Ann. tit. 36, § 670–425 (Purdon, supp. 1954).

[23] Cal. Sts. & H. Code Ann. §§ 100.2, 941.2 (Deering, 1953); Fla. Stat. § 348.06 (1953); Ill. Stat. Ann. c. 121 §§ 340, 341 (Smith-Hurd, supp. 1954); Ore. Rev. Stat. §§ 374.060, 374.065, 374.070 (1953); Pa. Stat. Ann. tit. 36, §§ 2391.4, 2391.7 (Purdon, supp. 1954).

[24] Fla. Stat. § 348.07 (1953); Ore. Rev. Stat. §§ 374.075, 374.080 (1953); Pa. Stat. Ann. tit. 36, § 2391.11 (Purdon, supp. 1954).

tion of use restrictions, until such time as the highway authority is assured that the offending use will not be continued.

c. Making it a misdemeanor to enter or leave a highway at any location, for any use, or in any manner not authorized by the applicable access-control provisions and providing fines or imprisonment, or both, for violations.

Conclusion

Every highway construction program should include an appropriate access control plan that will be courageously carried to completion. In formulating policies and practices for control of access to highways, it is desirable for the highway authority to make a thorough investigation, study, and analysis of the present and future highway needs to determine the highways to which no direct access from abutting property should be allowed, and the highways to which limited access, controlled as to location, design, and use, can be had with safety.

The basic principle of access control is an abrupt departure from traditional unlimited rights of access to public roads from abutting property. Public acceptance of access-controlled highways and elimination of fear of the effect of such highways upon the value and use of adjacent properties can only be obtained by a continuing educational program to inform the public of the needs and purposes of access control and the benefits to be received therefrom. Although construction of adequate, fast, and safe highways is the primary concern of highway authorities, damage to abutting properties should be kept to a minimum consistent with the paramount highway requirements by providing appropriate and necessary interchanges, frontage roads, connecting roads, and other facilities that will permit, and in fact induce, the maximum development and use of property when the public interest will thereby be best served.

The Law of Retail Gravitation Applied to Traffic Engineering

HARRY J. CASEY, JR.

Mr. Casey was research analyst for several years with the Maryland State Planning Commission where he carried out research into various aspects of the state's economy and served as administrator of the State Capital Improvement Program. Following this, he was with James W. Rouse and Company, a mortgage banking house and developer of shopping centers, where he participated in the research and planning of numerous shopping centers in the Baltimore area and throughout the east. Mr. Casey currently operates his own market research firm specializing in retail location research. He also is consultant to the Committee on Mass Transportation, recently formed by the mayor of Baltimore to investigate various solutions to this crucial problem.

THE law of retail gravitation used by market analysts to estimate sales at proposed shopping centers has gained increased acceptance in the last few years. The same conceptual principles inherent in its application to retail location theory appear to apply equally in many phases of traffic engineering and city planning. This paper is written to indicate the need for further exploring the validity of these suggested uses.

In 1929 William J. Reilly[1] formulated the law of retail gravitation which bears his name. The law states that two towns share the retail purchases of an intermediate place in direct proportion to the population of the towns and inversely with the squares of the distances between the towns and the intermediate place. This is formulated as $\frac{S_1}{S_2} = \left(\frac{P_1}{P_2}\right)\left(\frac{D_2}{D_1}\right)^2$ where S_1 and S_2 are the sales made by the two towns to the residents of the intermediate place, P_1 and P_2 the population of the towns and D_1 and D_2 the distances from the towns to the intermediate place.

In general, tests of Reilly's law have confirmed that it is a reasonable approximation of the distribution of trade. Later work in-

[1] William J. Reilly: "The Law of Retail Gravitation," New York, 1931.

dicates that the exponent varies with the kind of merchandise. Investigation also has shown the exponent will vary according to the size of the city: a very large city "pulls" trade in greater proportion than is indicated by the ratio of its size to that of a very small city.

More recent developments in the use of the retail gravitation principle have adapted it for allocating to any number of "towns" the purchases of any number of "intermediate places." By using this adaptation of Reilly' law the purchasing power of each of the residential areas (intermediate places) comprising the trading area of a city can be allocated with reasonable accuracy to each of the retail areas (towns) in the city.

This adaptation states that the purchases of the residents of a neighborhood (usually a census tract or group of tracts) are attracted to the retail centers in direct proportion to the size of the centers (expressed in square feet of retail area) and inversely as the squares of the driving time-distances from the neighborhood to the retail centers. This is expressed as:

$$B_{1.a} = \left[\frac{\frac{F_a}{(D_{1.a})^2}}{\frac{F_a}{(D_{1.a})^2} + \frac{F_b}{(D_{1.b})^2} + \frac{F_c}{(D_{1.c})^2} + \frac{F_d}{(D_{1.d})^2} \cdots + \frac{F_z}{(D_{1.z})^2}} \right] \times B_1$$

where B_1 is the buying power of neighborhood 1; $B_{1.a}$ the purchases made by the residents of neighborhood 1 in retail center A; F_a, F_b, F_c, etc., the square feet of retail space in the retail centers A, B, C, etc.; $D_{1.a}$, $D_{1.b}$, $D_{1.c}$, etc., the driving time-distances between neighborhood 1 and the retail centers.

It is apparent that while the concept of size and distance as the determining factors in the distribution of trade remains unchanged from Reilly's original formulation, the expression of these factors has radically changed. For size of city has been substituted size of retail space; for distance, driving time. Further, instead of limiting the law's use to measuring the effect of only two cities upon an intermediate population group, this reformulation can demonstrate the effect of an infinite number of possible shopping opportunities.

Rephrasing the law in this manner, it is believed, has achieved a more accurate representation of the forces conditioning the consumers' shopping choices. Size of retail space implies a measure of the total amount of merchandise available at a given location, and it

is generally agreed that the attraction of any retail facility is directly influenced by the size of the available merchandise presentation. Reilly's use of population size as a measure of retail influence is a crude measure, since many small cities, because of geographic accidents, have trading areas totally unrelated to the population of the city, as conversely, many large cities have restricted trading areas.

Similarly, the use of driving time, instead of distance, reflects more accurately this determining factor in shopping trip choices.

This method, it should be pointed out, is applicable only to the determination of how *shopping goods* purchases are allocated. Shopping goods include general merchandise, apparel, furniture and home furnishings—the types of merchandise bought relatively infrequently, subject to comparative shopping (whence their name), and attracting the shopper for greater distances than does the other broad category of merchandise, convenience-goods. Convenience-goods include principally foodstuffs as well as drug store items, hardware and similar weekly needs. Convenience-goods typically are sold in the neighborhoods, and attract purchasers only for a distance of five or six minutes (in an urban area).

Application in Traffic Analysis

In measuring potential sales for a proposed shopping center, the market analyst divides the problem into two phases. The first, using the law of retail gravitation as expressed in the formula discussed earlier, is to estimate the potential shopping goods sales at the center. Second, using what has been called a "watershed" analysis, the convenience-goods sales are estimated. This involves delineating a natural trading area based on geography, competition, road patterns and similar factors, and applying to the convenience-goods purchasing power in the trading area certain judgments as to the amount that will be spent at the center.

In general, in a large shopping center shopping goods customers and convenience-goods customers, at any time, are two distinguishable groups. The housewife who comes to do her weekly marketing is not—at that time—an apparel buyer. Thus, two separate analyses are needed.

After volumes of sales are determined the market analyst, preferably in conjunction with the traffic analyst, will translate estimated

annual dollar sales into estimated annual customers, which in turn are broken down into customers (or automobiles) by month, day of the week, and hour of the day. From these data are constructed parking, access and highway needs.

By carefully outlining the neighborhood boundaries so that estimated purchases (customers—automobiles) can be allocated to the highway network leading to the center, the origin of customers by direction can be estimated. This estimate enables the traffic analyst thereby to pinpoint possible areas of congestion and plan for adequate, well-placed points of ingress-egress.

In general, mass transportation plays only a small role in carrying customers to the new suburban shopping centers. However, in case a center is well-served by mass transit, some weight must be given to customer-use of this form of movement. Further, certain neighborhoods may have a markedly low level of automobile ownership, which affects the mobility of these potential customers and should be noted in the analysis.

To illustrate the technique of estimating the potential shopping goods sales at a planned center, the following hypothetical situation is used. Let us assume an urban area which is readily divided into ten neighborhoods or residential areas. Further, in this urban area are five concentrations of shopping goods stores varying in size from 50,000 to 300,000 square feet. Table I lists the necessary data and the calculations used in arriving at potential sales for a proposed center of 100,000 square feet of shopping goods space.

TABLE 1

		RETAIL AREA "A" 50,000 Sq. Ft.		RETAIL AREA "B" 300,000 Sq. Ft.	
[1]	[2]	[3]	[4]	[5]	[6]
Neighborhood Key #	Shopping Goods Purchasing Power	Square of Driving Time To Neighborhood	Retail Size ÷ Square of Time	Square of Driving Time To Neighborhood	Retail Size ÷ Square of Time
1	$3,000,000	25	2.00	256	1.17
2	4,000,000	36	1.39	169	1.78
3	7,000,000	81	.61	196	1.53
4	3,200,000	169	.30	324	.93
5	2,000,000	144	.34	400	.75
6	4,400,000	25	2.00	400	.75
7	1,500,000	9	5.56	324	.93
8	7,400,000	16	3.13	256	1.17
9	5,300,000	9	5.56	289	1.04
10	2,500,000	64	.78	289	1.04

		RETAIL AREA "C" 200,000 Sq. Ft.		RETAIL AREA "D" 60,000 Sq. Ft.	
[1]	[2]	[7]	[8]	[9]	[10]
Neighborhood Key #	Shopping Goods Purchasing Power	Square of Driving Time To Neighborhood	Retail Size ÷ Square of Time	Square of Driving Time To Neighborhood	Retail Size ÷ Square of Time
1	$3,000,000	169	1.18	9	6.67
2	4,000,000	121	1.65	9	6.67
3	7,000,000	144	1.39	16	3.75
4	3,200,000	256	.78	64	.93
5	2,000,000	324	.62	121	.50
6	4,400,000	256	.78	49	1.22
7	1,500,000	289	.69	16	3.75
8	7,400,000	196	1.02	9	6.67
9	5,300,000	225	.89	9	6.67
10	2,500,000	484	.41	81	.74

		RETAIL AREA "E" 60,000 Sq. Ft.		PROPOSED SHOPPING CENTER— 100,000 Sq. Ft.	
[1]	[2]	[11]	[12]	[13]	[14]
Neighborhood Key #	Shopping Goods Purchasing Power	Square of Driving Time To Neighborhood	Retail Size ÷ Square of Time	Square of Driving Time To Neighborhood	Retail Size ÷ Square of Time
1	$3,000,000	100	.60	64	1.56
2	4,000,000	121	.50	25	4.00
3	7,000,000	196	.31	9	11.11
4	3,200,000	324	.19	16	6.25
5	2,000,000	361	.17	9	11.11
6	4,400,000	121	.50	16	6.25
7	1,500,000	64	.93	81	1.23
8	7,400,000	81	.74	49	2.04
9	5,300,000	64	.93	81	1.23
10	2,500,000	81	.74	289	.35

[1]	[2]	[15]	[16]	[17]	[18]
Neighborhood Key #	Shopping Goods Purchasing Power	Sum of Cols. 4, 6, 8, 10, 12 and 14	Estimated % of Purchases That Will Be Made in Center [Col. 14 ÷ Col. 15]	Estimated Sales at Center [Col. 16 x Col. 2]	% of Total Estimated Sales From Each Neighborhood
1	$3,000,000	13.18	11.8%	$ 354,000	2.6%
2	4,000,000	15.99	25.0	1,000,000	7.4
3	7,000,000	18.70	59.4	4,158,000	31.0
4	3,200,000	9.38	66.6	2,131,200	15.9
5	2,000,000	13.49	82.3	1,646,000	12.3
6	4,400,000	11.50	54.3	2,389,200	17.8
7	1,500,000	16.09	7.6	114,000	0.8
8	7,400,000	14.77	13.8	1,021,200	7.6
9	5,300,000	16.32	7.5	397,500	3.0
10	2,500,000	4.06	8.6	215,000	1.6
			Total Estimated Sales	$13,426,100	100.0%

NOTE: Under actual conditions it would be nearly impossible for a shopping center of 100,000 sq. ft. to produce sales of $13,426,200. Further, a center of this size normally could not expect to capture such high proportions of the area's purchasing power as this example shows for neighborhoods #3, 4, 5 and 6. This illustration is not based on any real situation.

The estimated sales of this center are distributed throughout the months of the year and the number of transactions per month estimated (on the basis of $7.50 per transaction).[2] These data are shown in Table II.

Table II

SHOPPING GOODS SALES AND TRANSACTIONS BY MONTH
HYPOTHETICAL SHOPPING CENTER

Month:	Percentage of Annual Sales:[3]	Estimated Sales by the Month:	Number of Transactions:
January	8.0	$1,074,000	143,200
February	6.6	886,000	118,100
March	8.1	1,088,000	145,100
April	7.2	967,000	128,900
May	7.8	1,047,000	139,600
June	7.5	1,007,000	134,300
July	5.8	779,000	103,900
August	7.1	953,000	127,100
September	8.1	1,088,000	145,100
October	9.0	1,208,000	161,100
November	10.3	1,383,000	184,400
December	14.5	1,946,000	259,500
	100.0	$13,426,000	1,790,300

However, on the average, only about one-half of the shoppers at the center will make purchases,[4] so to produce 1,790,000 transactions, 3,580,600 shoppers will visit the center. At the rate of 2.4 shoppers per automobile, 1,492,000 vehicles will annually be handled at the shopping center. During the peak month—December —216,000 automobile trips will be generated. These trips will be distributed hourly throughout the peak day—Saturday—as shown in Table III.

From these data, parking space requirements can be calculated. By the use of Column 18 in Table I, "Percent of Total Estimated Sales From Each Neighborhood," the traffic volumes on the access roads during this peak day, or any day, can be determined. Assume

[2] See Eberle: "The Retail Merchant's Interest in the Traffic Problem," The Traffic Quarterly, April 1951, Table IV.

[3] From "Fairchild's Financial Manual."

[4] Moorhees, Sharpe, and Stegmaier: Shopping Habits and Travel Patterns. Highway Research Board Special Report 11-B, Washington, 1955, p. 4.

Table III

DISTRIBUTION OF VEHICULAR TRIPS, HOURLY ON PEAK DECEMBER DAY[5]

	Total Automobiles:		
Hour:	In:	Out:	Accumulation:
9:00–10:00	954	154	800
10:00–11:00	1093	354	1539
11:00–12:00	1400	770	2169
12:00–1:00	1447	1170	2446
1:00–2:00	1308	1123	2631
2:00–3:00	1493	1231	2893
3:00–4:00	1431	1400	2924
4:00–5:00	1247	1724	2447
5:00–6:00	1200	1539	2108
6:00–7:00	1047	1123	2032
7:00–8:00	1339	1062	2309
8:00–9:00	1062	1324	2047
9:00–10:00	369	2201	215
	15,390	15,175	

that customers from neighborhoods 1, 2, and 3 will approach the site from the north, 4, 5, and 6 from the east, 7 and 8 from the south and 9 and 10 from the west. Then the number of vehicles bound for the center would approximate data shown in Table IV.

The foregoing analysis has indicated how parking and access requirements can be determined for the shopping goods section of a planned shopping center. As noted earlier, the convenience-goods potential of the center would be determined by a watershed trading area analysis, to which would be applied a different set of transactions, and monthly, daily and hourly sales data to derive similar traffic requirement estimates.

Other Uses of This Approach

The rationale of size of competing generators and driving time-distances as the determining factors in retail trade distribution appears to be applicable to other forms of traffic generators.

[5] These data are based on an unpublished study of traffic movements at a major regional shopping center.

Table IV

VEHICULAR VOLUME BY DIRECTION, HOURLY ON PEAK DECEMBER DAY

Hour:	Automobiles Arriving at Center	North:	East:	South:	West:
9:00–10:00	954	391	439	80	44
10:00–11:00	1093	448	503	92	50
11:00–12:00	1400	574	644	118	64
12:00–1:00	1447	593	665	122	67
1:00–2:00	1308	536	602	110	60
2:00–3:00	1493	612	687	125	69
3:00–4:00	1431	587	658	120	66
4:00–5:00	1247	511	574	105	57
5:00–6:00	1200	492	552	101	55
6:00–7:00	1047	429	482	88	48
7:00–8:00	1339	549	616	112	62
8:00–9:00	1062	435	489	89	49
9:00–10:00	369	151	170	31	17
Total:	15,390	6,308	7,081	1,293	708
Percent of all traffic: *		41%	46%	8.4%	4.6%

* These percentages are derived from Column 18, Table 1.

Further investigation into the number of office employees clustered in various intra-urban employment centers may prove fruitful. If an urban area were to be divided into neighborhoods as described above, and the number of white collar workers[6] determined, a measure would be had of the quantity and location of the market for these employees (comparable in the retail analysis to purchasing power). Secondly, the urban area's employment centers would be located and their size as generators determined (perhaps in terms of total white collar employment). While driving time in this type of analysis may not necessarily be raised by the exponent two, it probably plays a similar role in determining work trips as it does in shopping trips.

By an analysis of this kind, the effect on highway needs of chang-

[6] The U. S. Census of Population reports by census tract the number of persons in each of the following employment classifications: Professional, technical, and proprietors, and clerical and kindred workers. These categories comprise the group designated broadly as "white collar."

ing employment patterns, as well as new decentralized office centers could be measured cheaply and expeditiously.

In similar fashion, changing industrial employment patterns could be weighed for their effect on the city's traffic system. Further, the impact of highway improvements and new highways could be estimated by using the new driving-times they would introduce, and some measure obtained of the additional traffic they might generate.

In general, this method might very well provide a substitute which could be used at regular and short periods for the expensive origin and destination survey. Indeed, further research might well be made into this technique's applicability to traffic engineering.

Do Road Signs Affect Accidents?

A. R. LAUER AND J. CARL McMONAGLE

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Mr. McMonagle is Director of the Planning and Traffic Division of the Michigan State Highway Department. Previously he was assistant director and before that was in charge of the Traffic Section of the Highway Planning Survey. Altogether he has been with the Michigan State Highway Department for the last nineteen years. He is a member of the Institute of Traffic Engineers; the Michigan Society of Planning Officials; the Michigan Engineering Association of State Highway Officials; the Highway Research Board, and of the President's Highway Safety Conference.

THE science of highway safety is in its infancy. Many opinions are expressed regarding the causes of traffic accidents, and many notions about highway safety are unfounded. Quiet, easy-riding cars, smooth curveless roads, policed highways and similar improvements have not eliminated accidents entirely. Too much depends upon the human factor. More needs to be known about optimal conditions for efficient driving before the best results in safety on the highway may be obtained.

The problem of driving safety has interested the Driving Research Laboratory of Iowa State College for many years. Knowing this, the Outdoor Advertising Association of America in 1950 asked the laboratory to undertake a project designed to evaluate the various angles of vision in front and at the side of the driver with respect to the efficiency of signs. At the same time it was proposed that an

Editor's Note: For years, those concerned with traffic accidents have wondered whether any relationship exists between advertising road signs and traffic accidents. The studies reported here give a clear picture. One study, made in the Driving Research Laboratory of Iowa State College, is reported by Dr. Lauer. The other study, made in the field by the Michigan State Highway Department in cooperation with the United States Bureau of Public Roads, is reported by Mr. McMonagle. Correlation between the two studies was made by Dr. Lauer.

attempt be made to establish some relationship between placement of signs and the possible "distraction" of the driver. As the project developed it appeared that a driver rarely keeps his eyes on the road directly ahead. He must do some observing about him to enjoy driving, to keep awake, and to follow normal habit patterns in use of the eyes developed since childhood. Therefore, it seemed conceivable that an optimal level of stimulation would have a beneficial effect upon driver efficiency. An experiment was set up to test this hypothesis.

Apparatus Used and Method of Approach

Since resources were limited some of the apparatus used at Iowa State College (described in References 2 and 3) was adapted for these purposes and redesigned to fit such an experiment. Advertising signs were placed at various angles from 0 to 45 degrees to each side of the roadway and subjects were run on the apparatus to determine what statistically significant difference, if any, existed between efficient observation of a landscape covered with signs and that of a landscape with no signs at all. All other features were the same. Fifty subjects were first run using reaction time as the criterion of possible "differential efficiency effects." No significant differences were found in this study which was considered as a pilot run to the main research. This was against expectation.

Subsequently 120 more subjects were run, four groups of thirty matched subjects each. One group was used as a control in a preliminary run. The second part of the study consisted of ninety subjects, thirty in a group, run under three conditions of the landscape as described below.

In one condition the landscape was entirely clear of signs. In the two other conditions signs were placed at different angles to the side to evaluate any differences which might be noted if the signs were close to the road or were placed farther away from the road and the line of vision. Other features such as a radio tower, fields, shrubs, trees, farm buildings, roads, bridges, animals and even an electric train, all in miniature, were kept on the landscape for all three conditions. These are shown in Figures 1, 2 and 3. To summarize, the three conditions varied were: (a) no signs, (b) signs placed 15–30 degrees to the side, and (c) signs placed 15–45 degrees at the side.

Tests Favor Signs

Briefly summarized, the laboratory results showed that numerous signs in the driver's field of vision in no way influenced efficiency at the wheel adversely, and in fact seemed slightly beneficial. The difference was about 10 percent in favor of conditions with signs.

It was also noteworthy that the driver would notice as many or more other objects and features of the landscape when the signs were present as when they were absent. In other words, the theory that various signs along the highway will detract from the natural beauty does not seem to hold. A person will observe and keep in mind what appears to him as the most interesting stimuli along the highway regardless of the frequency and density of distribution within the limits studied.

Michigan Studied 100-Mile Highway

The Michigan State Highway Department, in cooperation with the U. S. Bureau of Public Roads, made a study of accidents and their relation to design and roadside features along a selected trunkline highway. The selected study section was a 100-mile stretch of highway on US24 from the Ohio State line to the intersection with M58 just south of Pontiac, and on M58 from that intersection to its junction with US10 northwest of the city.

Carefully considered measures, including a comprehensive inventory of all design and roadside features, were taken to obtain accurate data concerning types and location of both features and accidents. The 3,025 accidents on this road reported in 1947, 1948 and 1949 were used in all phases of the study except those involving correlation where only the 1,968 accidents reported in 1947 and 1948 were used.

From data recorded and tabulated by IBM, one card was prepared for each accident, and one card for each of the 119 *intersection* and 144 *non-intersection sections* into which the study road was divided. Almost all of the analysis work was done for the *intersection* and *non-intersection sections* separately.

While the study itself treated design features, roadside establishments, private drives and advertising signs with near-equal concern, attention here will be centered on advertising signs.

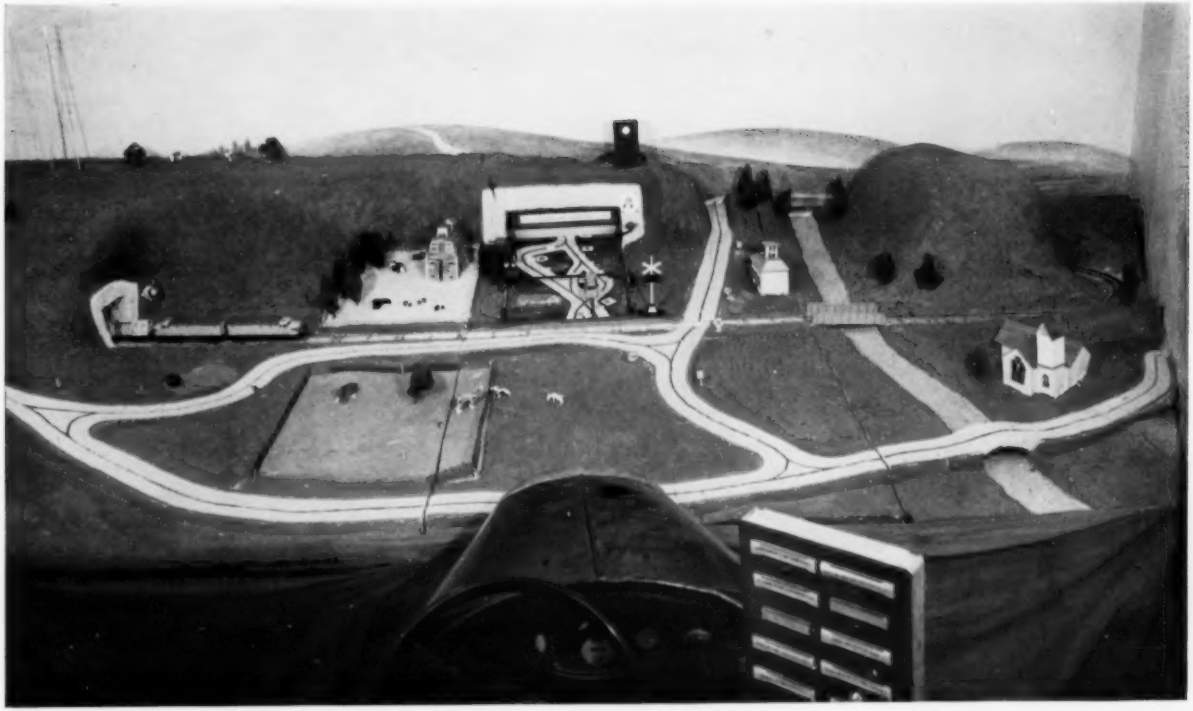

FIGURE 1. Landscape without signs of any kind. This was used as a control condition.

FIGURE 2. Landscape with signs shown within the limits of 15–30 degrees.

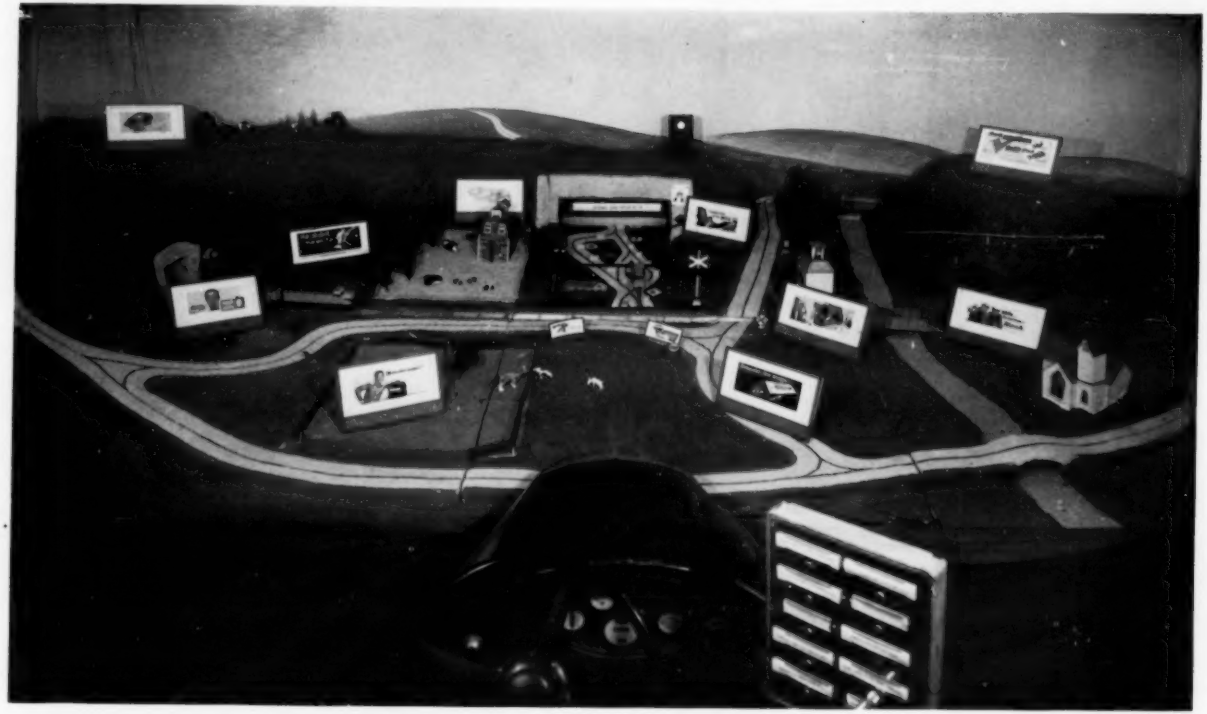

FIGURE 3. Landscape with signs placed from 15–45 degrees at the side.

The problem was approached by several methods. The first of these was to compute the rate of accident-occurrence per large and prominent advertising sign, at each of five 100-foot increments of distance of the accident from such sign. The second method was accident and sign density. In each section the total number of accidents in 1947 and 1948 was divided by the section length in hundreds of feet. Then the relationship between accidents and advertising signs was again evaluated by calculation of correlation coefficients—both simple and multiple.

These three methods gave no conclusive results because they did not take into account the relationship between advertising signs and roadside features, design features or private drives. Correlation coefficients among these various factors show them to be highly inter-related.

To determine the extent to which each of the factors, including advertising signs, was related to accidents in its own right and independent of other factors, partial correlation coefficients were computed. Nine different factors were each correlated with accidents by means of eighth order partial correlation coefficients. This was done for *intersection* and *non-intersection sections* separately. The nine factors together with the partial and the zero order correlation coefficients are shown in the following table:

Table 1

PARTIAL AND TOTAL CORRELATION COEFFICIENTS OF ACCIDENTS WITH EACH OF FIVE TYPES OF ROADSIDE FEATURES: PRIVATE DRIVES, DESIGN FEATURES, ADVERTISING SIGNS AND VEHICLE MILES FOR NON-INTERSECTION AND INTERSECTION SECTIONS

Features Correlated with Accidents	Non-Intersection Sections		Intersection Sections	
	Total	Partial	Total	Partial
Taverns	.313	.332	.698	.460
Gas Stations and Commercial Garages	.442	.144	.666	.365
Stores	.321	−.047	.526	.166
Restaurants	.438	.212	.651	−.026
Other Establishments	.443	.302	.720	.131
Private Drives	.513	.265	.264	−.132
Design Features[1]	.303	.226	.285	.122
Advertising Signs	.557	−.066	.712	.002
Vehicle Miles	.680	.444	.720	.256

[1] Except grade separations, piers and abutments.

In this table the advertising signs as well as the other factors are shown much nearer their true relationship with accidents. An inspection of the partial correlation columns of Table 1 makes it clear that advertising signs make no significant contribution to accidents along the highway included in this study. The great difference between the zero order and partial coefficients for advertising signs is a good indication of the extent to which signs and other features are inter-related. This point should be kept in mind in future studies.

By the same type of approach, accidents were correlated with total roadside features: private drives, design features, advertising signs and vehicle miles by fourth order partials. The results again showed no relationship between accidents and advertising signs.

Any correlation coefficient does not necessarily show the existence of a cause and effect relationship between variables considered. In the present instance it appears that advertising signs have no relationship to accidents on the route under study.

Other Evidence

The effect of properly placed design and roadside features in breaking the monotony of driving is recognized. The experience of drivers on today's turnpikes is evidence of this. Designers of the New York Thruway recognized the need for variety of roadside stimuli by designing otherwise unnecessary curves in that highway. This phenomenon of driving monotony is undoubtedly related to the Minnesota Highway Department's findings that sharp curves or turns at the end of *long* tangents were much more hazardous than at the end of *short* tangents.

The Michigan study shows that the accident problem on the route studied is not one of driver-attention diverted by advertising signs, but is probably a matter of roadside friction from uncontrolled access and egress to certain types of business establishments and private drives. There is also the problem of exposure and traffic volume represented by vehicle miles in this study.

With two types of approach the general conclusion was that little, if any, relationship exists between advertising signs and accidents. However, the whole set of correlations had not been thrown into a multiple R as is frequently done in studies of this type. The Driving

Research Laboratory of Iowa State College was able to cooperate with the Michigan Highway Department by securing the zero order correlations and putting all variables together to compute multiple correlations for *intersection sections* and *non-intersection sections* by the Doolittle method. This is a special mathematical process whereby a set of normal equations is solved to determine the degree of relationship existing between each of the variables put into the equation and the criterion which in the present case was accidents.

Using the Michigan State Highway Department data, an analysis was made of the two conditions which had been isolated, namely, *non-intersection sections* and *intersection sections* as related to accident occurrence.

Results Shown by the Michigan Study

While a number of multiple correlations were computed by the Michigan Highway Department it is known that the best method of determining relations is to use all variables in the equation and calculate their respective components or betas. Here will be named only the variables in the order of their contribution. The possible significant items will be indicated.

Table 2

MICHIGAN STUDY—FACTORS RELATED TO ACCIDENTS
(INTERSECTION SECTIONS)

Multiple R = .8748 Factors Measured = 76+%

Variable	Order of Importance	beta	r	Coefficient
Taverns	1	.3368	.6983	.23518744
Vehicle miles	2	.2947	.7200	.21218400
Gas stations	3	.2877	.6662	.19166574
Other establishments	4	.1184	.7198	.08522432
Stores	5	.1095	.5261	.05760795
Design features	6†	.0642	.2851	.01830342
Advertising signs	7†	.0024	.7123	.00170952
Restaurants	8†	−.0209	.6511	−.01360799
Private drives	9†	−.0869	.2639	−.02293291

† Contribution not significant.

In order of importance with respect to *intersection sections*—that is, that part of the highway the Michigan Highway Department had

designated as intersections—the relationships found were in the following descending order of importance: Rank one shows the closest relationship to accidents, and rank nine, the least association to accidents.

It is noteworthy, however, that 7, 8 and 9 (advertising signs, restaurants and private drives) were either negative, showing a beneficial effect, or were not significant at all because of their extremely small betas, the accepted index of separate relationship.

As to the *non-intersection sections*—that is, the stretches of highway between crossroads and accident occurrence at or near signs as described by the Michigan Highway Department—the variables studied assumed the following descending order of relationships. (Order interpreted as above.)

Table 3

MICHIGAN STUDY—FACTORS RELATED TO ACCIDENTS
(NON-INTERSECTION SECTIONS)

Multiple R = .8155 Factors Measured = 67%

Variable	Order of Importance	beta	r	Coefficient
Vehicle miles	1	.4216	.6796	.28651936
Private drives	2	.1932	.5133	.09916956
Other establishments	3	.2035	.4425	.09004875
Restaurants	4	.1796	.4381	.07868276
Taverns	5	.2127	.3126	.06649002
Gas stations	6†	.1040	.4420	.04596800
Design features	7†	.1465	.3026	.04433090
Stores	8‡	−.0330	.3211	−.01059630
Advertising signs	9‡	−.0639	.5575	−.03562425

† Scarcely significant.
‡ Non-significant. Actually negative or beneficial if anything.

Many times zero order correlations, when considered separately, will seem to indicate a relationship. If the amount of overlapping is partialled out the betas may be extremely low, insignificant, or even in the opposite direction. Note the last four variables under the beta column and coefficient of both Table 2 and Table 3.

The reason for a wide fluctuation in relative values for a variable such as private drives may be that they are rarely found at *intersection sections.*

Here again items 8 and 9 (stores and advertising signs) were slightly negative and therefore found to be slightly beneficial, if showing any relationship at all, in reducing accidents.

Thus a laboratory study under simulated highway conditions in which various factors could be controlled agrees almost perfectly with the outdoor studies of 100 miles selected as a typical highway in which the degree of relationship, if it existed, might be shown between accidents and advertising signs and other roadway and roadside features. The studies each confirm that there is no significant relationship shown between outdoor advertising signs and highway accidents. The evidence, if any, is slightly in favor of having something along the highway to arouse the motorist and keep him alerted as far as efficient driving is concerned. These results fit in very well with what is known about efficiency of performance in many other areas from various psychological experiments. A certain amount of "distraction" would seem necessary, if it may be so designated, to keep the driver or performer alert and at his highest level of efficiency. See references (1) and (4).

Vehicle miles travelled was one of the highest relationships as one might expect. Design features and advertising signs showed little or no relationship on this particular highway and in these studies. The fundamental point is that if enough drivers who are susceptible to accidents pass over a given highway some are going to get into trouble. The problem is to keep those likely to get into trouble at a high state of alertness to danger.

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Los Angeles' Off-Street Parking in Smaller Business Districts

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WITHIN the 452 square miles included in the official Los Angeles city limits, approximately 1,180,000 motor vehicles are registered. Consequently, a great variety of parking problems exist with many alternative solutions offered for improvement. Generally in the larger business districts such as downtown central business district, Miracle Mile, Hollywood, and Crenshaw, private enterprise has provided a great amount of off-street parking either in open-air lots or in multiple-level garages.

The twelve-story height limitation on buildings definitely limits business concentrations and land values and makes possible the somewhat unique development, as compared to most other large cities, of large numbers of open-air parking lots. Many of these have proved to be semi-permanent because they have remained in existence for many years. Several large multiple-level garages, however, have been built to serve increasing parking demands beyond the economic capabilities of open-air lots.

The largest of these was the Pershing Square Garage with approximately 1,800 car spaces in the heart of the central business district. This furnishes the only instance in the city of municipal participation in creating a parking garage. This garage consists of three parking levels built under a city park, and the city's participation was limited to its share of the planning and to a long term lease of the space under the park to private operators.

Lack of off-street parking in the smaller business districts has

been a matter of serious concern to the mayor, the council, the traffic commission and the traffic manager. Many city departments and citizens' organizations have been working toward a comprehensive program of relief. The concentration of capital in the larger business districts has implemented the creation of off-street parking, but the same result has not occurred in the majority of smaller business districts.

Smaller Business Districts

In the earlier days, curb parking served the demand fairly well until after World War II. Then the huge population growth caused not only a large outward growth from the former metropolitan perimeter, but also a filling in of the vacant space around business centers already existing.

The outward expansion in Los Angeles County has resulted in an urban metropolitan area of some nine hundred square miles and a registration of approximately 2,400,000 motor vehicles. Many of the older business districts of comparable size, outside the city of Los Angeles, have parking problems very similar to those within the city. During the rapid postwar growth many new communities have been established around shopping centers planned to include off-street parking. Outside the older districts, new drive-in supermarkets and department stores in areas where ample space for free parking is economically available have accented the problem in the older districts.

In some districts this competition has caused a downward trend in business property values evidenced by a lowering of assessed valuations while in the newer areas there have been sharp increases. A definite and well-demonstrated awareness of the parking problem in the smaller communities is becoming widespread over the whole metropolitan area.

Increasing Curb Turnover

Heavy traffic demands on a street system which has not been improved commensurately with the huge post-war traffic growth, necessitate many curb parking restrictions especially during peak hours. Opposed to this measure, retail merchants in the smaller areas more

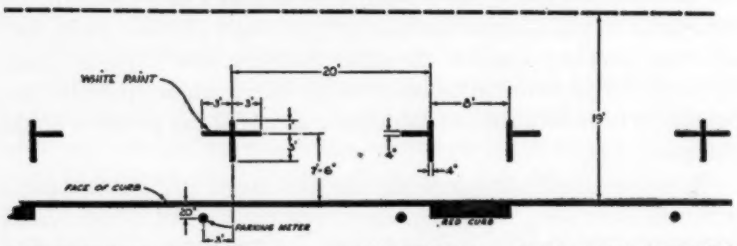
immediately favor increasing curb turnover through the use of parking meters. This solution is not feasible in the larger business districts since traffic demands there have so increased that all-day parking bans cover most of the available curb space.

Since curb metering offers a relatively short-term solution in the smaller districts contrary to long range street-space demands of a fast-increasing automobile population, the city has adopted a policy which includes parking meter zones as the first step in the acquisition of off-street parking. However, where the parking demand is not sufficient to justify the installation of parking meters, some positive improvement is desired.

Unmetered Stalls

To improve the efficiency of curb parking where time limit restrictions are posted in a congested business district, the Los Angeles board of traffic commissioners has recently adopted a policy that provides parallel painted stalls 7 feet 6 inches wide and 20 feet long with eight feet of red curb separating pairs of stalls. (Figure 1.) This procedure prevents the blocking of cars while parked, lessens the hazard

DESIGN OF PARALLEL PARKING STALLS



Angle of Parking at Curb	*Width of Street Used When Parked*	*Width Needed for Parking Plus Maneuvering*	*Length of Curb Per Car*	*Cars Parked Per 100 Ft.*
PARALLEL	7	19	20	4.2

FIGURE 1. Parking Stall Layout for Congested Business Districts with or without Parking Meters.

while pulling out from the curb, and permits ease of parking. Although this type of stall is now standard under traffic commission policy where a meter zone is requested, the painting of such stall lines is gradually being accomplished in all congested business districts even though meters have not been requested.

Previously it has been customary to require a one-hour parking restriction in effect where such stalls are painted. An experiment is now proposed in the use of such stalls to relieve parking problems when intense demand for curb parking space is occasioned by frequent events staged at a large auditorium. This auditorium has large parking lots adjacent, but either to avoid paying the fee or because of the lots' lack of capacity, many persons attending the events use curb space on adjacent residential streets.

This is a multiple-dwelling neighborhood with frequent in and out movements from the driveways to the garages of the apartment houses. Because of the close parking arising from the intense demand, cars often block entrance and exit at the driveways besides making it very difficult to pull in or out from the curb. In addition to the red curb section between pairs of stalls, curbs will also be painted red next to driveways to make enforcement much more uniform and certain where driveways are willfully blocked.

Parking Meter Zones

Where it is desired to improve the turnover of cars parked at the curb, organized groups—such as chambers of commerce, business men's associations, or other civic groups—may make an official request to the board of traffic commissioners for a parking meter zone in a business area. The department of traffic will then conduct surveys in the area affected and recommend to the business men's group the extent of the area in which a metered zone would be justified.

After a conference with the group, the department will prepare detailed maps of the streets involved, taking into consideration the existing red curb areas, loading zones, driveways, etc. This layout is then submitted to the group for their consideration. During these meetings local newspapers publicize the intention of the merchants to install meters in the area involved.

Other considerations discussed in the conferences are the original cost, installation and maintenance of meters and collection by the city clerk's personnel of coins deposited in the meter boxes. Revenues from the meters are deposited in a parking meter fund in the city treasury earmarked under the parking meter zone ordinance for use in the zone of origin. Meters are usually purchased by con-

tract with manufacturing companies paid by a pledge of one-half the revenues from the meters in that zone.

This revenue, based on experience with 3,000 meters located in many different business areas, is sufficient to pay for the meters in less than two years. Bidding procedure is used by the city purchasing agent in the awarding of the contract. Cash purchases have sometimes been financed in the past by use of a revolving fund set up within the parking meter fund. Meters are maintained by the traffic department which is allowed a parking meter repairman and truck for each 500 to 700 additional meters.

It is also called to the attention of the requesting business group that use of the metered parking spaces is limited to those hours when peak period parking restrictions are not effective. Recently, well-defined warrants for peak hour parking restrictions have been adopted by the traffic commission after conferences with the enforcing agencies. The municipal traffic regulations affecting such restrictions have been revised and condensed to implement simplified signing and positive enforcement.

Peak hour restrictions necessary for the dense traffic on the main street in a congested business district are usually paralleled by a high curb turnover. Consequently the annual revenue per meter has proved to be as high in districts where peak hour restrictions are in effect as in the lesser districts where warrants do not yet exist for peak hour restrictions.

When conferences with the business group are concluded, a report by the department of traffic is prepared and submitted to the traffic commission. This report recommends creating a parking meter zone and listing the number of parking meters required for that installation, including the number of spare parking meters required for maintenance.

Upon approval by the traffic commission the report is sent to the city council, and an amendment to the parking meter zone ordinance prepared, which is then voted on by the city council and approved or disapproved by the mayor. If approved, it is published in the Legal Journal and becomes effective thirty days thereafter. The purchasing agent purchases the meters under bidding procedure although the council may authorize their purchase at an earlier date. The meters are installed either by the department of traffic or the

vendor, and the zone goes into operation. This procedure is mentioned in detail because the parking situation is so acute in most districts that business groups become very impatient with any delay.

Income from Parking Meters

At the beginning of the calendar year of 1955, a few more than three thousand meters were in operation in nine meter zones (Figure 2). Gross municipal income from these meters is shown in Figure 3.

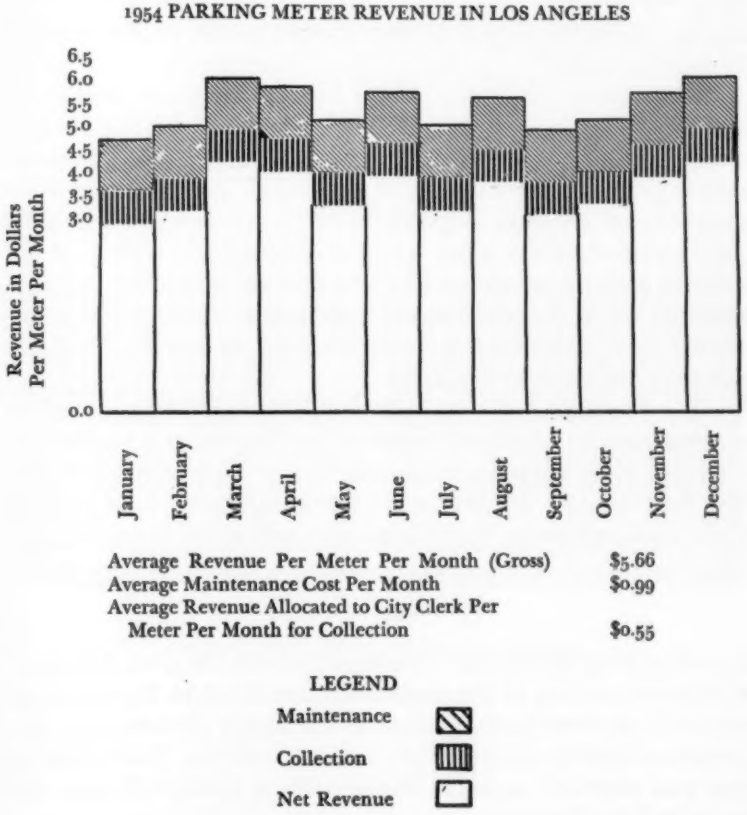


FIGURE 3. Gross Average Revenue per Meter per Month.

Actual maintenance costs for 1954 averaged $0.99 per meter per month, which is somewhat higher than reported in other cities. Our cost includes, however, these items: (1) labor, including meter repair and cleaning, painting posts, heads, and parking stalls, and inspection of meters; (2) cost of material including mechanical parts and paint; (3) cost of equipment, including depreciation of repair trucks; and (4) administration as 15 percent of the cost of labor and material. This kind of inspection and preventive maintenance insures that the public will find a minimum of meters out of order. A daily inspection usually reveals approximately one percent of the meters out of order. About one-half of this percentage is due to the introduction of foreign objects into the meters by the public or other forms of vandalism.

All meters in the city register for five cents per hour or one cent for twelve minutes. Two nickels may be deposited for two hours if there is no one-hour parking restriction. Most of the older business areas in Los Angeles are developed along single streets. In such areas one-hour parking is usually required for the metered portions of the main business district street, and a two-hour limit placed on the metered portions of side streets. On the one municipal off-street parking lot now existing, five-hour parking is allowed at the meter rate of one cent for twelve minutes, five cents for one hour, and five nickels or a quarter for five hours.

Since January 1, 1955, nine new meter zones and four extensions of existing zones have been approved, totaling about 3,000 meters. A total of nineteen meter zones will be operating within the next sixty days of which six have made a written request for a parking district although several of the remainder have made an oral request.

Parking Districts

A positive program has been developed to meet the great deficiency of off-street parking in the smaller business districts. In such areas very little off-street parking exists, as the nuclei of these older districts were developed during the era of curb parking. As the districts grew and extended outward, fringe parking involved longer and longer walking distances.

Newer shopping centers, planned from the beginning with

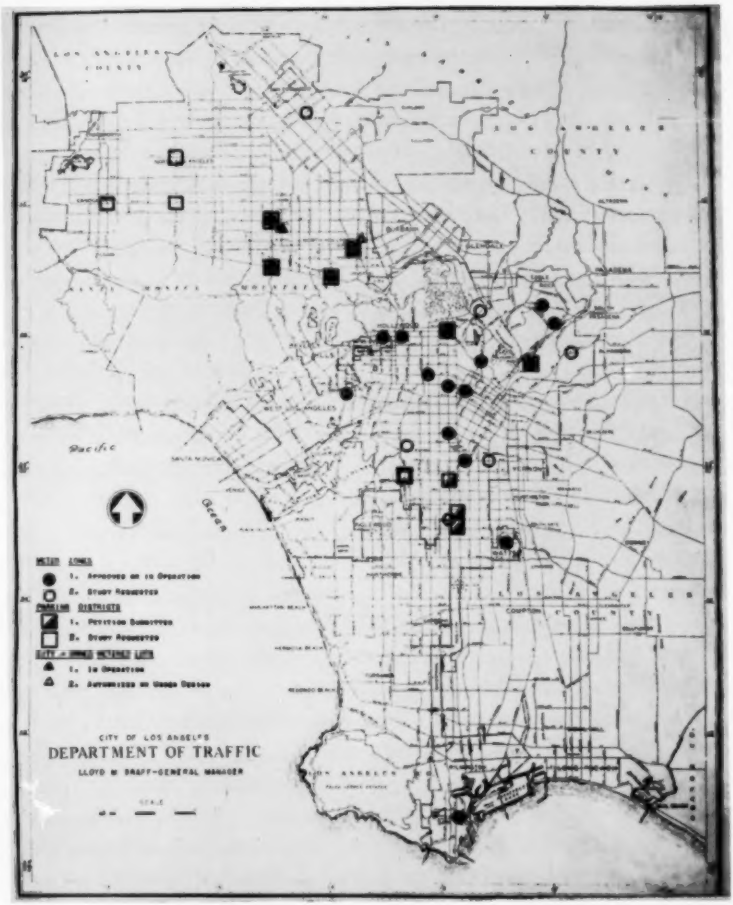


FIGURE 2. Meter Zones and Parking Districts.

ample and inviting off-street parking space, proved the value of reasonable parking facilities by their rapid growth. The maxim that customers will walk little more than five hundred feet from a parking lot to a business establishment proves to be even more true in the Los Angeles area in which growth has depended on a much greater use of the private automobile than in some other large cities.

Zoning regulations do not offer much help to such districts. For new small retail stores, offices and businesses, the requirement is one space for each thousand square feet of floor area in a building containing seventy-five hundred or more square feet. This is no more than a gesture in an area where recently a new department store found it should provide three square feet of parking space for every square foot of floor area.

Many such districts are confronted with the problem of checking a decline by providing off-street parking immediately. Others unable to finance off-street parking in the near future desire increased turnover on the curb spaces, and wish to prepare for obvious future needs. Their dilemma is to provide methods of accumulating funds for future growth. A parking meter zone of 500 meters will accumulate a fund at the rate of about $25,000 annually after maintenance and collection costs are deducted and the meters are paid for.

Since the acquisition of off-street parking in the smaller districts is so difficult, two state laws have been passed permitting business men to create business districts and obtain parking lots through condemnation. Lots acquired are also exempt from taxation. Both acts depend upon initiating petitions from the business men specifying the location of the lots, the extent of the district, and the act under which they wish to proceed. One is a rather well established assessment district act and the other is a later revenue bond act.

Motor Vehicle Parking Act of 1943

The 1943 assessment district act provides that the initiating petition may ask that an assessment of not more than 35 percent of the assessed valuation of the land, exclusive of improvements, be levied to acquire specified lots and pay the cost of improving the lots to specific standards for parking. This 35 percent of the assessed land value has not proved adequate for the needs in some instances and an amend-

ment is before the state legislature to increase the assessment to 35 percent of the assessed value of the land *and* improvements.

Lots may be planned on a free basis, fees may be charged by meters, or lots may be leased to private operators. An annual income from meters or fees may be used to offset yearly payments on assessments which went to bond, or as a rebate for an assessment paid in cash if the council approves. If there was an accumulation of revenue from a parking meter zone in the proposed district, it is requested in the petition as the city's contribution to financing the district.

While the state law sets a 35 percent minimum, the city council's policy requires that signatures to the petition represent 51 percent of the area subject to assessments within the proposed district. This precaution is to avoid the Act's provision which declares the proceedings void if a majority of the area protests at the hearing on the Ordinance of Intention to form the district. A provision of the amendment raising the assessmcnt to 35 percent of the assessed value of the land and improvements requires that signatures represent 60 percent of the area. When the proceedings pass the point at which assessments are levied, the assessments automatically go to bond if not paid in cash within thirty days after notice of assessments is given.

1943 Act Proceedings

The main outline of proceedings under this Act follows:

1. Local business association appoints a three-man parking committee and requests department of traffic to make study.
2. Department of traffic surveys district, makes preliminary study as to district boundaries, lot locations, financial aspects, and designs parking lot layout according to approved city standards.
3. Department of traffic confers with planning department as to general plan, zoning aspects, etc.
4. Department of traffic requests board of public works (city engineer) to review legal description of district and proposed lots and to check applicability of standards to the particular locations.
5. Department of traffic notifies business group who then prepares preliminary petition.
6. Department of traffic requests city attorney to review preliminary draft of petition.
7. District parking committee prepares and circulates petition for required signatures.

8. City clerk checks petition (or has it checked) and presents to council.

9. Planning department initiates procedure for any necessary zone change.

10. Council orders final design and estimates of cost from board of public works (city engineer).

11. Council passes resolution and ordinance of intention and sets hearing on resolution and ordinance of intention thirty days at least therefrom.

12. Council holds hearing on resolution and ordinance of intention.

13. Protests by property owners may cause amendments necessitating another hearing.

14. Council adopts final ordinance.

15. City attorney files any condemnation suits or negotiations are made for direct purchase through-right-of-way and land bureau (public works).

16. Court renders interlocutory judgment or city signs contract for acquisition of lots.

17. Costs for proposed lots, improvements, engineering and incidentals are obtained by the city engineer. Assessments are spread by the bureau of assessments and hearing set thirty days thereafter.

18. Council holds hearing on assessments.

19. Assessments recorded and collected by bureau of assessments.

20. Treasurer issues bonds for unpaid assessments thirty days after recording. Bonds sold and proceeds into special fund with collected assessments.

21. Acquisition completed by payment therefor.

22. Board of public works lets contracts for improvements.

23. (Proposed) three-man committee of the board of traffic commissioners appointed by mayor and council as parking commission.

24. Improvements accepted by board of public works and opened to public use.

25. (Proposed) board of traffic commissioners control and operate parking district in all matters of rates, maintenance, preferential contracts, recommendations to city council for expansion, etc.

It usually takes a minimum of about eighteen months to complete proceedings under this Act when no delays occur under condemnation. If there are delays in acquiring the land, or by changing first decisions, the proceedings may take much longer.

Because of the length of proceedings it may happen that property owners will decide to build on lots described in the petition as proposed parking lots. In one such instance the city council had to intervene and order immediate condemnation of three lots lying in the center of a tier of lots proposed for the parking district. An office building was proposed on the three lots which would have benefited immensely by having flanking parking lots if the council

had not taken action. Finances for this immediate acquisition were available from accumulated revenue from the meter zone within the district which had been in existence there for years.

In another district an apartment building is proposed on the only available vacant lot in that part of the district. This was a key lot proposed as a parking lot in a petition already submitted to the city council. Since this district has had no meter zone, funds are not available for immediate acquisition and the district is confronted with a serious problem. An act exists, however, which gives to any city the right to exercise eminent domain in acquiring property for off-street parking.

Motor Vehicle Parking District Act of 1951

This Act is essentially a revenue bond act with the net income from the parking meter zone, including both the metered stalls on the curbs and on the off-street parking lots, pledged to retire the bonds. The maximum period of the bonds is thirty-one years. In addition to the meter revenue, an assessment, not to exceed fifty cents per $100 of assessed valuation of land and improvements, may be asked for in the petition.

An amendment is now before the state legislature to raise the maximum bond term to thirty-five years and the assessment limit to one dollar per $100. This assessment is only to be levied for any year in which there is insufficient net revenue to pay interest and principal on the bonds.

Proceedings under this Act are also initiated by a petition from a business group. However, the policy of the city council is to require signatures of owners representing fifty-one percent of the assessed valuation of the land and improvements since this would be a sufficient protest to void the proceedings.

1951 Act Proceedings

The main outline of proceedings under this Act follows and is essentially the same as 1943 except in the last few steps:

1. Through 16 approximately the same as 1943 Act.
17. Bonding ordinance, prepared by city attorney and special counsel em-

ployed by the city upon the request of the petitioners, passed by city council who sets amounts and terms of bonds and ad valorem assessment (according to petition).

18. Sale of bonds completed by city treasurer, acquisition completed and contracts let for improvements by board of public works.

19. (Proposed) three-man committee of the board of traffic commissioners appointed as parking commission by mayor subject to approval by council.

20. Improvements accepted by board of public works and opened to public use.

21. (Proposed) board of traffic commissioners control and operate parking district in all matters of rates, maintenance, preferential contracts, recommendations to city council for expansion, etc.

Time of the proceedings is approximately the same as in the 1943 Act. It appears to be desirable to install a meter zone for a year or more prior to submission of the petition to prove the revenue available for retirement of proposed bonds.

Parking Districts Being Formed

No parking districts have been completed under either of these two Acts in the city of Los Angeles. The city of Pomona in the metropolitan area of Los Angeles has successfully used the Act of 1943 as have other towns outside this area. One town in northern California has successfully used the 1951 Act. The short time since the passage of the 1951 Act has not proved sufficient for completion of those districts attempting to use it. For this reason, a completed district in a major urban area is being awaited with interest by all.

Thirteen districts have started proceedings within the city of Los Angeles, of which four have submitted petitions, three under the 1943 Act and one under the 1951 Act (Figure 2). Of the remaining nine, three have elected to proceed under the 1951 Act, one under the 1943 Act and the remaining five have made no choice as yet.

Traffic Department as Coordinating Agency

Many problems common to all districts necessitate contact with the traffic department. Prior to initiating petitions, many of the districts had already queried this department regarding the formation of

meter zones. Knowledge of parking demand and proper location of off-street parking for ease of entry and access are essential to the proper functioning of off-street lots. Such lots are commonly located behind the business frontage which is located on a major street. Merging and departing from traffic streams are much more easily accomplished in the less congested side streets and the concentrations can then be brought into the major artery under planned regulation.

Other situations frequently involve the designing of parking facilities to fit the traffic flow. Abandoned rail rights-of-way, separating vehicular roadways and acquired by the city after the change from rail to bus operations, present a problem as to best use. Merchants often wish to use the center strips, whose widths vary from fifty to sixty feet, for angle parking. This is contrary to good traffic operations because pedestrians must cross roadways, usually densely traveled, to get to the business frontage.

FRONTAGE ROADWAY WITH ANGLE PARKING ON MAJOR TRAFFIC STREET

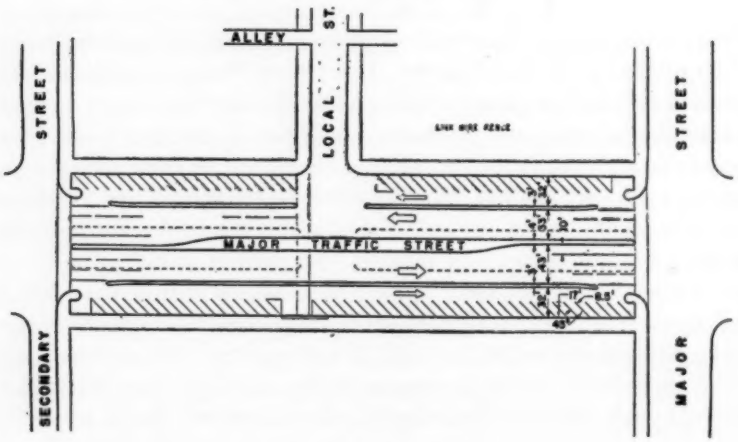


FIGURE 4

An alternative recommended by the department would place the angle parking on the other curbs in separate frontage roadways, leaving the main roadways in the abandoned center strip with a minimum of interruption to their flow (see Figure No. 4). This

FIGURE 5. Arrow Indicates Frontage Roadway Which Merchants Wish Converted to Angle Parking.

angle parking may also be metered since it is especially invitational to customers in that walking distance is a minimum. Such design is also being considered on a boulevard which has an existing central through-roadway flanked by frontage roadways. Here the merchants have requested that the present parallel parking on the frontage roadways be changed to angle parking (Figure 5).

The traffic department is by nature the agency for consultation on such matters. In addition to inherent responsibility it has been proposed that the department also be designated as the coordinator for all matters relating to meter zones and parking districts. In this way, all requests for information as to status, delays, the formation of districts, preliminary estimates, etc., are directed to one department.

The department should be implemented to carry on more detailed studies of the parking demand in each district. Besides studies of turnover on the curbs and existing off-street parking lots, the department is investigating other methods of measuring parking demand within a district. Revenue from individual meters measures variation of demand within the district and establishes the fringe demand. Relationship of parking demand to gross floor area of retail establishments and gross volume of various types of business transacted remains to be established.

A survey of tributary population based on questionnaires to customers of business establishments offers another possibility. In the early stages of forming meter zones, the above relationships may be regarded as somewhat academic. As districts are formed, especially under revenue bond proceedings, the factors become vital. Without full information a meter zone may be established on a conservative basis with the proviso that an extension can be based on an average revenue per meter at a later date. For districts, however, an investment of several hundred thousand dollars needs the facts established by a more detailed survey.

Administration of Parking Districts

Both the 1943 and 1951 Acts provide that three parking place commissioners shall be appointed by the mayor, subject to confirmation by the council, for each parking district. The Acts do not, however, require that such members must be from the district to which they

are appointed. Therefore many city officials reason that provisions for appointing such commissioners were framed for small towns or cities having one central business district with no outlying smaller business districts.

They further advocate that the same commission be appointed for all districts and that three members of the traffic commission constitute such a parking place commission. This recommended procedure would avoid a cumbersome multiplicity of commissioners and would insure uniformity of administration in the many districts to be formed. District representation would be achieved by having a committee of three business men chosen for each district to present its particular problems.

The administration and operation of a district will involve the requirement that lots are fully maintained and serviced and that fees are sufficient to maintain the parking lots and amortize the original investment. Also steps may be taken to extend the district, acquire more lots or dispose of lots already acquired.

Other Procedures for Off-street Parking

In general, off-street parking may be publicly acquired under California laws by legislative bodies, either as an authority proceeding or as a district proceeding under the two Acts already mentioned. Authorities are financed either by general obligation bonds or by revenue bonds.

An Act of 1949 gives cities the power to acquire property by purchase, lease, or condemnation. It provides for issuance of revenue bonds, if voted by the people, to finance parking. Cities may set parking rates and lease out the facilities to private operators and may pledge income from on-street parking meters to pay principal and interest on bonds. So far no California cities have acquired parking facilities under this Act.

San Francisco, Santa Monica, San Jose and Modesto have created parking authorities. Sacramento was the first California city to issue revenue bonds for parking purposes.

Oakland has a plan which has been well publicized and is familiar to many interested in off-street parking. This is a cooperative association of merchants which buys or leases land for off-street

parking lots. One-hour validation of customer tickets is paid for by a pro-rata share of costs and other revenues are derived from overtime parking charges and night operation of lots.

Berkeley has approved a plan whereby the business men's group will pay one-half the cost and the city the other half. The city is to finance the plan and the original cost will be recovered from contributions by the business men and property owners and revenues from parking lots and meters.

Sacramento, following a charter amendment adopted in 1948, issued revenue bonds and bought lots near the downtown shopping district. Of parking meter revenue bonds totaling over $200,000 annually, $50,000 was pledged toward the amortization of a $1,600,000 bond issue in 1951.

Comparison of Methods

The trend in California has been to let private enterprise solve parking problems insofar as possible. The power of eminent domain plus tax exemption makes municipal ownership attractive to smaller business districts. Loss of taxes due to governmental ownership of parking lots is balanced against an almost certain increase in taxes from enhanced property values of business establishments using the tax free lots.

The parking district Acts were endorsed by the Los Angeles chamber of commerce and the downtown business men's association after debate had brought out that the Acts were framed for use in the smaller districts where rates chargeable were so low that private operators had not provided and would not provide parking. The revenue of five cents an hour has not attracted private investment in fee lots to date. The aggregate of revenue from meters may, however, be integrated with eminent domain and tax exemption to make municipal sale of bonds for such parking districts possible. Also, many of the districts wish to establish free parking by using the 1943 Act to compete with new subdivisions which included free parking for their business districts.

Some have advocated that a parking authority be established for all the parking districts within the city of Los Angeles. They contend that the lengthy district proceedings would be eliminated and

that progress would be much more rapid and certain. On the other hand the city would be in the position of acting as a mediator in commercial rivalries between communities and between business establishments within districts. Other large cities do have such authorities but these cities do not have the spread of population that exists here nor the multiplicity of small business districts. Such authorities are formed more for the purpose of supplying additional parking facilities to one central business district in a small city or town. A certain amount of centralized control in a large city is highly desirable, but it may be that this can be achieved by having all districts under one commission.

The future of the current district parking program here depends to a large extent on the success of proceedings under the 1951 revenue bond act. Many districts are reluctant to proceed under assessment act proceedings even though parking meter revenues can be used to offset assessments if the city council approves. The formation of a district under the 1951 Act is awaited with much interest. The 1943 Assessment Act, however, is well proved and may be even more successful if proposed amendments are adopted by the legislature.

An Answer to Multiple Jurisdiction

M. EUGENE BAUGHMAN

Mr. Baughman has for eight years been planning director of the St. Louis County Planning Commission. He has had fifteen years' experience in city planning and engineering including work with the Illinois Division of State Parks, as assistant planning director in Louisville, Kentucky, and in federal housing projects. A registered professional engineer in Illinois and Missouri, Mr. Baughman is consultant to Missouri municipalities on planning, zoning and municipal administration and advisor on county plannng to the Metropolitan Plan Association. He is a member of the American Society of Planning Officials, the International City Managers' Association and of the Building Official Conference of America. In 1952, he received the Distinguished Service Award of the United States Junior Chamber of Commerce.

THE area of St. Louis county, Missouri, is approximately 493 square miles. Of this, about 120 square miles, comprising the built-up urban area surrounding the city of St. Louis, is incorporated under the jurisdiction of ninety-six municipalities. These vary from eleven to 5,875 acres; their populations vary from fifty-seven to 39,892 persons.

The fringe area around the incorporated area is under the jurisdiction of the St. Louis county council, which functions not only in relation to the statutory county functions, but also serves as a municipal agency under the terms of the new St. Louis county charter adopted in 1951. St. Louis county's population has grown from 274,000 in the 1940 census to 538,000 in 1954. The motor vehicle registration has increased from 83,000 in 1940 to 154,674 in 1954.

The St. Louis county highway engineer has funds only for the maintenance of county highways outside the jurisdiction of the ninety-six municipalities, and traffic control in the unincorporated area is under jurisdiction of the St. Louis county council and the state highway patrol. Within the incorporated areas the state highway commission traffic policy sometimes conflicts with the policy of the ninety-six municipalities. In some instances the municipal boundary lines are the center lines of rights-of-way of major high-

ways with the result that the speed limit on one side of a highway often differs from that on the opposite side.

In other instances major intersections in need of traffic signals come under the jurisdiction of two or more municipalities. Since 1940, fifty-seven municipalities were formed, and forty-eight of the ninety-six towns have an assessed valuation of less than one million dollars. Thirty of the ninety-six have an area of fewer than 100 acres. Thus, the responsibility for the widening of pavement, the installation of traffic signals, and provision for other traffic relief facilities cannot be assumed completely by the municipality because most of the traffic factors come from external forces beyond the limits of the municipality. A major highway may traverse eight or more municipalities. The width of the paving and the width of the right-of-way may vary to either a greater or lesser dimension as the route progresses through the municipalities. It seems unbelievable that no major railroad grade separation has been constructed in St. Louis county for eighteen years. The only project has been that of widening a grade separation. Most of the railroad grade separations of the past came from major projects by the state highway commission or were incidental to a location where the railroad was willing to cooperate because the existing topography made the convenient installation of a railroad grade separation an economical part of its program.

The maintenance of federal and state aid highways in St. Louis county is under the state highway commission for the state maintained highways; the county highway engineer has jurisdiction over major highways in the unincorporated areas not under state jurisdiction. Within the ninety-six separate municipalities, ninety-six separate agencies maintain municipal streets which are an integral part of the county system and yet are not on the program of the state highway commission or county highway engineer.

Under this arrangement the distribution of cinders in times of snow or ice is without any central control; ambulances, fire trucks, and other public facilities, as well as mass transportation, trucking, and automobile activities are seriously curtailed even when a minor snow or icing condition exists. The rolling topography of the area, near the foothills of the Ozark region, causes surprise conditions for motorists in many instances where visibility is poor on major highways or where intersections are located beyond hillside approaches.

Any study of the circulation of people and vehicles should encompass highways, traffic, and mass transportation. At the same time, any county-wide approach to traffic and safety should include parallel phases of financing and traffic research as well as the installation of physical facilities. In preparing for bond issues before the people of St. Louis county in 1955 and 1956, the St. Louis county planning commission staff found it necessary to analyze rights-of-way widths through all municipalities, the number of driving lanes, the number of parking lanes, and the desire lines of vehicles of all types.

Central Traffic Research Agency

Since there is no official means for coordinating and receiving accurate data on physical facilities, accidents, and information concerning traffic conditions and delay factors at various locations in St. Louis county, the state highway patrol and the sheriff's office cannot be expected to maintain such records with their limited budgets and limited jurisdiction. The St. Louis county planning commission urged the St. Louis county grand jury in 1948 to encourage the establishment of a Central Traffic Research and Records Agency as a first step in providing an answer to the traffic problems in St. Louis county. The results and recommendations were forwarded to the charter committee and in turn the St. Louis county council established an agency known as the Traffic Violations Bureau.

Although the agency serves only the unincorporated area, and was not exactly the agency requested, it has made progress and enabled the planning commission staff to secure from the traffic violations bureau traffic data and accident facts useful in preparing recommendations concerning bond issues and traffic relief facilities. Steps are now being taken to urge the state highway patrol, the county traffic violations bureau, the sheriff's office, the constable's office and the offices of the chiefs of police in the ninety-six municipalities to use uniform traffic accident report forms. Complete statistics will thus be available to focus attention on intersections, railroad grade crossings, or major highways having an unusual number of accidents or fatalities.

The metropolitan metamorphosis which brought about the mul-

tiple jurisdiction, the increase in population, and St. Louis county's change from a rural area to a major metropolitan center, has caused a need for a complete review and changed form of government to enable St. Louis county to function as one city in matters strictly of community-wide scope rather than of local interest. It is recognized that minor streets, their construction and maintenance, and traffic control for minor streets can for the most part be under local jurisdiction. However, the collector streets, secondary major highways, and major highways forming part of the interstate and intercommunity system must be coordinated under some central agency.

Municipality League Coordinates Activities

St. Louis county is fortunate in having a league of municipalities which provides unofficial coordination of activities among the various municipalities and a clearing house for mutual problems of city attorneys, city engineers, and police officials. Much cooperation exists between the chiefs of police and city engineers among municipalities adjacent to each other and needing joint action.

In 1953 the metropolitan St. Louis chamber of commerce established a traffic integration committee which developed a master traffic plan eliminating *on-street parking* on certain radial arteries during morning and evening peak traffic periods in the city of St. Louis. Where violations of the traffic plan exist, the St. Louis ordinance requires tow trucks to remove any automobile parked on the street during the time of prohibition.

This plan resulted in handling greater volumes of traffic on the streets; reducing travel-time for vehicles to reach their destination increased the spill of traffic from the major radial arteries in the city to the north-south major arteries in St. Louis county. These are beyond the limits of the city of St. Louis where the traffic plan is in effect. The impact of the city's traffic plan caused the St. Louis county chamber of commerce, cooperating with the metropolitan plan association, to form a traffic integration committee to coordinate traffic control in the ninety-six cities of St. Louis county. A kit of traffic questionnaires and recommendations was mailed to the ninety-six municipalities and Figure 1 was an effort to determine which municipalities were affected by the flow of traffic from each of the fourteen major radial arteries.

In many instances it was found that some municipalities were in two or more segments affected by the radial flow as shown in Figure 1. This chart looked like another monster from the atomic age and its

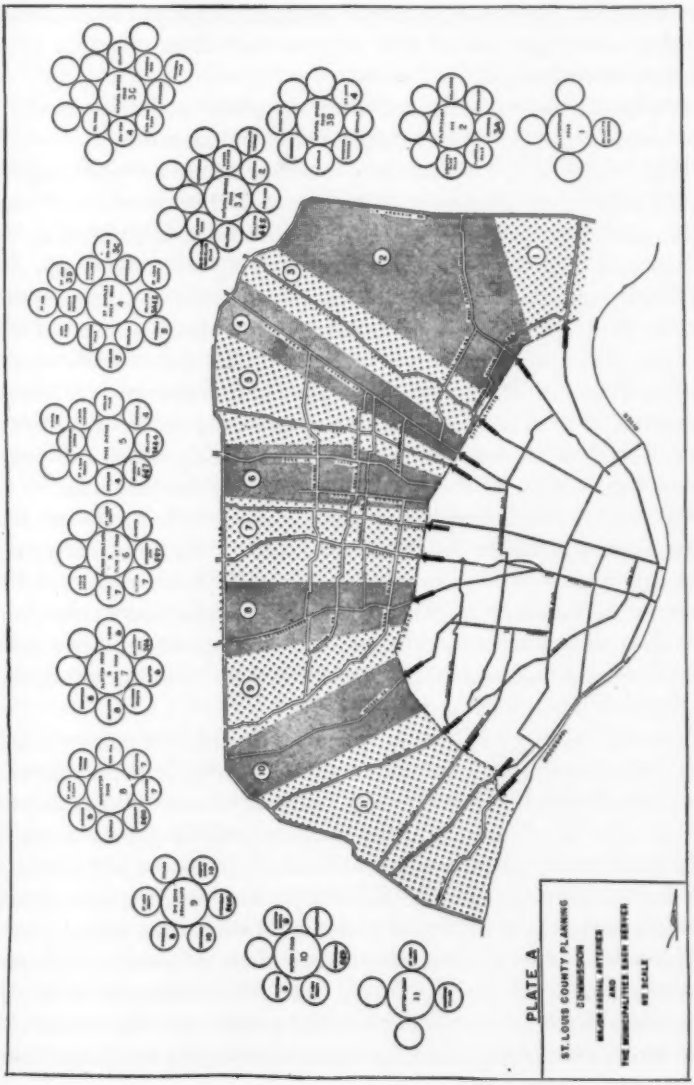


FIGURE 1. Major Radial Arteries

only contribution was to show the complexity of the problem in St. Louis county. Since the traffic integration committee was not an official body, the most direct action on traffic problems was obviously accomplished when the St. Louis traffic commissioner met with the chief of police of a municipality immediately adjacent to St. Louis, and that municipal official met with another chief of police of an adjacent municipality.

Accomplishments activated with complete authority made it clear that all effective plans must be by official sanction.

Conditions in St. Louis county therefore are in a strictly experimental stage as they relate to traffic control. The recently created department of police of St. Louis county, in contradistinction to the limited jurisdiction of the office of county sheriff, offers hope for establishing a traffic research agency as part of the new police department services. Although the St. Louis county police department will not have jurisdiction in municipalities unless the officials of the municipality contract for the use of the central agency, it is hoped that the creation of the department will make it possible to establish traffic control as one function in which all municipalities will cooperate as soon as they see the value of the public safety features.

St. Louis county's hospital in Clayton, Missouri, is adjacent to a major highway, Brentwood Boulevard, one of the most congested highways because of its intersection with Clayton Road, a radial artery one-half mile south of the hospital. This road has a volume of more than 20,000 cars a day at that intersection, and promises to be even more congested as soon as a major department store now under construction is put into operation.

Since the St. Louis county hospital serves all of the county's residents even though they live in ninety-six municipalities and the unincorporated area, it behooves the people of St. Louis county to provide not only the physical facilities to make possible speedy access to the hospital but also to focus attention on the need for added traffic facilities, so that many sick and injured persons needing ambulance attention can get to the hospital with a minimum time delay.

Many fire trucks are unable to reach their destination because of the steep grade of streets and lack of cinders during icy weather. An extreme example is that of an injured person who had to remain on the street after being struck by an automobile at a city limits line,

because there was doubt as to which police department should be notified to take the injured person to the hospital. By the time private assistance could be secured, it was too late.

Multiple Jurisdiction Affects Records

In 1948 when the planning commission first tried to determine whether accident records were available, it found that the law and limitations on the sheriff's office budget made it possible for his staff to keep records only on the basis of the name of the person injured or killed. These were listed alphabetically under accidents, deaths, and suicides, with no card file or dot map showing accident location or frequency. Investigation of records in the St. Louis county hospital's bureau of vital statistics showed that in many instances accident location was not required and the victim died at the hospital without a record of the scene of injury.

Under the recent reorganization of the school districts in St. Louis county there are now thirty districts. Traffic problems affecting school children and school buses focused even greater attention on the problems of multiple jurisdiction. One experimental problem by the planning commission staff included coordination of efforts by the officials of two schools, two Parent-Teachers Associations, two municipalities, the county traffic violations bureau, the St. Louis county highway engineer, and the state highway commission. This case revealed the complexity of the situation and illustrated why a decision was necessary to have one-way rather than two-way traffic, and the need for installation of certain traffic signals or facilities. In some instances it is necessary to prepare two or three solutions from which the affected boards may select a suitable plan. In some instances the merchants association or chambers of commerce are also added to the group.

Street right-of-way widths in St. Louis county and the width of paving in many instances were designed to accommodate only residential construction, as were storm water facilities and other sewerage. It is impossible to divorce highway and traffic facilities from other utilities and facilities in the right-of-way, and frequently the new industrial and commercial shopping centers are constructed in the islands left between developed subdivisions. There is often in-

sufficient capacity on the major streets to accommodate traffic flow from these new shopping and industrial centers.

The entire skeleton of the highway system must be adjusted to meet the changes in desire lines from a completely changing trend as a result of the mass decentralization taking place in the average metropolitan area. St. Louis county is no exception. Many of the industries constructed in suburban areas as part of the industrial decentralization program of the metropolitan St. Louis chamber of commerce are causing a complete shift in the desire lines of traffic. In some instances, county residents commuting to the city of St. Louis in the past are now using north-south routes rather than radial routes to reach their place of work. The decision of the federal government to place the Government Record Center and Printing Plant at the intersection of Page Boulevard and Woodson Road has resulted in the shift of the desire line of several thousand employees who have changed their place of work from the city of St. Louis to St. Louis county.

During these fifteen years when the population of the county doubled, the density pattern of the population changed to create a much greater need for north-south routes than in the past. The entire radial system of mass transportation should now be restudied to allow north-south desire lines without the necessity for radial routes as part of the complete north-south trip. Studies are being made regarding possible rapid transit monorail systems and collector parking areas for automobiles of commuters who wish to use rapid transit after they reach the fringe areas of the parent city.

The pickup and discharge of bus passengers has been greatly affected because of public utility poles and other facilities along highways with insufficient width of right-of-way. These highways were formerly under jurisdiction of the county highway engineer when the area was of undeveloped rural character, and that office required special permits from public utilities to locate poles. As soon as land is subdivided now and a higher density of population results, adjacent to these rights-of-way with sub-standard width, a small village or city incorporates the area and the jurisdiction is taken away from the St. Louis county highway engineer.

In many instances land developers or the municipality must pave parking lanes along the edge of the paving on the street of insuffi-

cient width, and public utility poles must be moved. Because the new municipality has no public works agency or regulatory facility to order installation by special permit by the public utility, and the public utility has previously secured a permit from the county highway engineer, a problem results. The cost of removing utility poles must be borne by the public agency and it generally lacks the budget to pay for relocating such facilities.

The location of utility poles along the highway often makes it impossible for buses to pull to the curb to discharge passengers; consequently passengers must risk the hazard of being struck by automobiles when leaving buses without the benefit of safety zones. St. Louis county needs more direct coordination and design of critical facilities when traffic studies disclose such need. A typical situation exists in the design of railroad grade separations. Determining the proportionate share of construction costs of railroad grade separations between the railroad and the public agency rests with the Missouri Public Service Commission.

The Public Service Commission will not consider an application in such cases, unless working drawings are submitted for the proposed railroad grade separations. The budgets of the small municipalities and St. Louis county allow no funds for establishing an agency which can employ personnel sufficiently qualified to prepare the working drawings; and the agencies are not willing to expend the funds unless they have some assurance that the Public Service Commission will make a proper allocation and that the people will support a bond issue necessary for constructing railroad grade separations.

There is a great need at the present time for railroad grade separations. The locations are so scattered throughout the county, however, that it is difficult to balance the expenditure of funds because the physical factors and geographical location of railroads do not directly relate to the centers of population density.

Efforts to determine the need for a Central Traffic Research and Records Agency included gathering facts on the number of automobiles using the highways in St. Louis county. The state highway commission keeps records of traffic counts on highways under their jurisdiction and on adjacent major highways which feed the state arteries. However, there is no agency which has an active record of

the number of vehicle registrations in St. Louis county. Each separate municipality has its own motor vehicle license bureau, and the state license bureau maintains a record of the city of St. Louis and St. Louis county as one unit. A central record bureau should make such records more easily obtained and make it possible to coordinate traffic accident data. The opportunity to compare such data with before-and-after analysis of intersections and highways in other cities, such as those furnished by the National Association of Traffic and Surety Agencies, is invaluable in working out solutions to problems.

When we depend upon state and federal governments to set policy on expenditures of funds derived from gasoline taxes, and many local governmental policies do not coincide with those of the higher agencies, we must have an agency that can produce the complete data essential to handle traffic.

There is great need in some St. Louis county areas for one-way street systems to enable existing highways to accommodate more vehicles and expedite the flow of traffic. Such a traffic plan is not possible without a central research agency to focus the attention of the municipal officials concerned in the situation.

A recent experiment to prove the benefit of a central traffic research agency is the intersection of Clayton Road and Big Bend Boulevard, where the city of Clayton and the city of Richmond Heights have combined jurisdiction. At one time this was the busiest intersection in St. Louis county and at present Clayton Road accommodates more than 30,000 cars, and Big Bend 15,000 cars, daily. An abrupt change in grade west of the intersection made it difficult for any change in design without serious expense to the city of Richmond Heights, and since the municipalities have always been reluctant to have the state take over Clayton Road for maintenance and traffic control, they decided to try a joint venture by the two municipalities and the owners of the filling station in the center of the island. (See Figure 2, "Before.")

One principal problem was the reduction of the west-bound Clayton Road lanes from three to two lanes as the west-bound cars crossed Big Bend Boulevard. A problem also existed because of head-on collisions when east-bound cars on Clayton Road continued eastward on the Clayton Road spur on the north side of the gasoline station, instead of making the curve to the southeast on Clayton

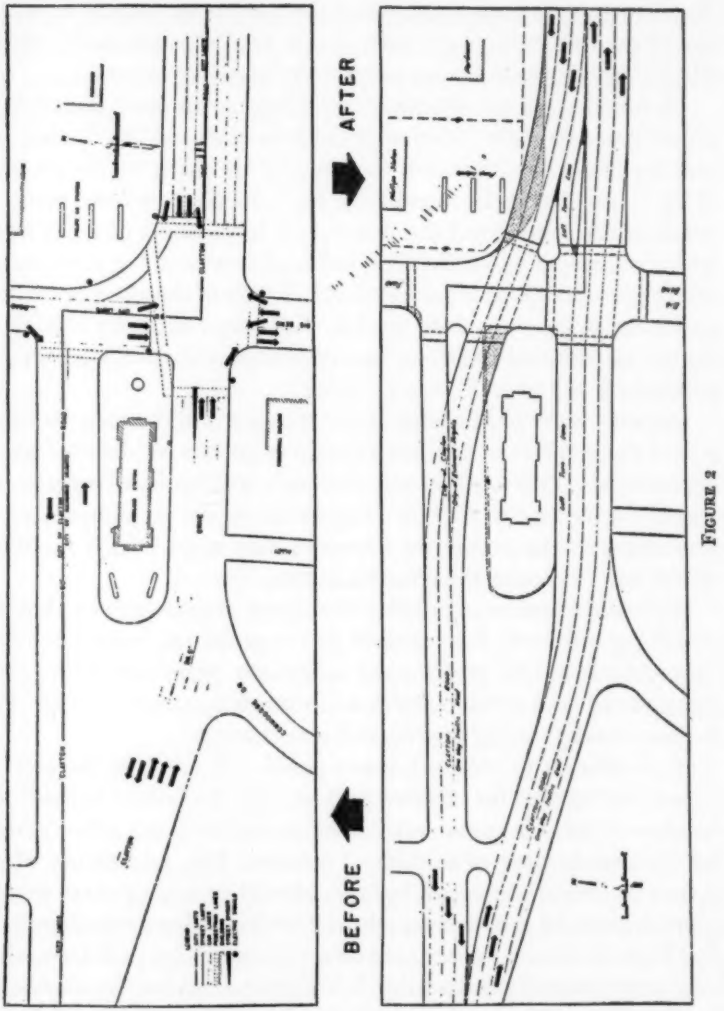


FIGURE 2

Road. At the same time traffic proceeded west on Clayton road after the traffic signal released them to cross Big Bend Boulevard and advanced at rapid speed toward the hazard point where Clayton Road and the spur meet.

The filling station management had decided to petition to vacate

the Clayton Road spur and move the station to the north, which would thus affect the right turn of cars headed south on Big Bend, when they turn onto the westbound Clayton Road spur.

A member of the planning commission staff had prepared detailed drawings of the location of the structures and the driving and parking lanes. He discovered that by slightly changing the location of the filling station the west-bound lanes on Clayton Road could be north of the station and the east-bound lanes south of the station, with the pumps and facilities moved farther west to use the triangle and prevent accidents caused by the confusion of the extra unmarked pavement to the west of the station. Full cooperation by officials of the two oil companies and two municipalities will correct this serious problems as shown in Figure 2, "After."

As soon as the public officials saw the merits of the plan they submitted the sketches to their own design engineers for detailed working drawings. This solution was obviously accomplished because the agencies were *official*. Citizens' organizations are very important in promoting public programs; however, they must have a qualified official staff to furnish them facts and data.

Recent tendencies in public and citizens' organizations to depend on zoning standards for relief on sewer problems, height control, light and air, and the problems of congestion, point the way for even greater need for a traffic research and records agency to provide data in determining zoning district and text changes.

It is difficult to convince many public officials that the lack of proper zoning laws for offstreet parking and the failure to limit the number of stores in commercial or industrial areas is a prime reason for the over-loading of municipal arteries. The availability of an agency to furnish necessary facts incidental to zoning texts should prove as essential as data from school boards on school enrollment, or data from the health department on sewer capacities, in determining long-range planning and zoning. It is doubtful that low requirements in off-street parking and unlimited height of buildings will be allowed if city officials see the true facts regarding traffic congestion.

Untrammelled circulation of people, raw materials, and produced goods in a community is as vital as the place of work, place of dwelling, and the cultural, recreational, political, economic, and sociological factors which shape the growth pattern of the com-

munity. Traffic and its time-space relationships take on new meaning with modern changes in transportation afforded by helicopters and monorail rapid transit. The traffic agency is a natural and imperative result of the changing trend in our technology.

Why Two Regional Shopping Centers Chose One Small Town

IRVING A. GERMAIN

Mr. Germain, an attorney at law, specialized during the last twenty years in real estate and particularly in the development of commercial realty and in negotiating and preparing long-term leases. He is president of the N. T. Hegeman Company, a firm established in 1910 and engaged in the development of suburban real estate, both residential and commercial. The Hegeman Company is the largest holder of commercial frontage on Route 4 in Bergen County. Mr. Germain is also a member of the Regional Plan Association of New York, the Urban Land Institute, and president of the Paramus Chamber of Commerce.

PARAMUS, N. J., has approximately 6500 residents. Yet the two largest regional shopping centers in the East are scheduled to start construction in the summer of 1955. They will be built within three-quarters of a mile of each other. One will be operated by Allied Stores Corporation, the world's largest department store group, owner of seventy-five department stores in the United States. Its Paramus center will be named Bergen Mall. The other, run by R. H. Macy and Company, Inc., will be called Garden State Plaza.

Why have these two retail merchandising Titans become close neighbors in a small town? What makes them willing to invest upwards of $30,000,000 each in highly competitive endeavors, at close range? While Paramus is an attractive and desirable American town, the reasons for this important decision lie mainly outside this small community.

After World War II, a nationwide increase in automobile registrations profoundly affected America's economy and "way of life." Not the least of these changes was rapid development in large regional shopping centers.

Before World War II, a few imaginative, resourceful pioneers successfully experimented with sizable retail centers outside urban

limits. Of these, Country Club Plaza in Kansas City, Mo. developed by J. C. Nichols, and River Oaks in Houston, Texas by Hugh Potter, were early prototypes. Since 1945, suburban regional shopping centers have come rapidly in all sections of the United States. Their effect was revolutionary on former shopping habits and retailing methods.

The constant process of urban decentralization, with steady loss in high purchasing power by cities to their suburbs, and increasing traffic congestion within the central city districts, have forced upon the department store, the apparel specialty store, and the chain store, the necessity of following their customers in the suburbs.

Most little cities, like most big cities, were not planned for the automobile age. Both are plagued with similar headaches. Regional shopping centers designed and built as entities in open spaces outside of central retail areas, are an inevitable solution.

Although suburban store agglomerations are newcomers to our merchandising scene, most of them products of the post-war era, the success that better-designed ones achieved has commanded interest and attention from both real estate and retailing industries.

Examples of the larger, well-designed, successful enterprises are Northgate, Seattle, Wash., Stonestown, San Francisco; Northland, outside of Detroit, and Hillsdale, San Mateo, California.

The Area

Paramus, in which Garden State Plaza and Bergen Mall will be built, is strategically situated in the center of Bergen County, N.J. About 15 percent of the land area of Bergen Mall lies in the adjoining town of Maywood. Bergen County, situated in the northeast corner of New Jersey across the Hudson River from New York City, contains 247 square miles.

On the east is the Hudson River and precipitous Palisades, a basaltic rock formation, rising 535 feet above sea level. In the center and upper middle sections, a series of low hill ranges, running generally north and south, alternate with streams running southerly to the Hackensack and Passaic Rivers. Terrain west becomes more rolling, ending at the Ramapo Mountains rising 1200 feet. To the

south, land trails off to an expanse of salt water marshes and meadows, along the Hackensack River and its tributaries.

Highways

The principal link between Bergen County and New York City is George Washington Bridge. Two other Hudson River crossings terminate in Hudson County, N.J., adjoining Bergen County, south.

Main highways, until recently, were N.J. Route 4 and U.S. Route 46, starting at George Washington Bridge, running in a general east-west direction. Also N.J. Route 17 runs in a general north-south direction, intersecting Routes 4 and 46.

In January, 1952, New Jersey Turnpike, a limited-access toll road, was completed, traversing the state diagonally from the Delaware Memorial Bridge in the southwest corner of the state to Ridgefield Park in the northeast, terminating at U.S. Route 46 three and a half miles west of George Washington Bridge. Plans recently announced will extend New Jersey Turnpike northward through Bergen County to the New York line, whence it will be connected to New York's Thruway.

Another limited-access toll highway, Garden State Parkway, is in its final stages of construction. This parkway is in operation from Cape May, at the extreme southeast tip of the state, to U.S. Route 46 in Clifton, across the Passaic River from Bergen County. By July 1, 1955, it is scheduled for completion to its present northern terminus in Paramus. It is planned shortly thereafter to extend Garden State Parkway northward from Paramus to New York's state line where it will meet a spur from New York Thruway.

Likewise in its final stages of construction by the state highway department is Palisades Interstate Parkway, a toll-free highway, starting at George Washington Bridge, running northerly along the scenic and historic Palisades to the state line where New York is carrying it northward to Bear Mountain, a total distance of forty-three miles. This attractive parkway will afford the motorist panoramic views of the Hudson River and its broad valley. At appropriate points there are parking areas and "overlooks" where the motorist may enjoy scenic beauty.

Bergen County is more than a large residential appendage of New York's metropolitan area. It has in its own right a respectable industrial backbone.

Population and Economic Growth

Rapid growth in Bergen County is indicated by its population statistics:

1930 Census	365,000
1940 Census	410,000
1950 Census	539,000
1954 population (estimated)	641,000

In 1960 the county may have a population of 750,000. Since 1940, a billion dollars' worth of new homes were built in the county.

Typical of recent industrial growth are Bergen County's Industrial Terminal, with sixty plants and 16,000 employees, and Ford's largest assembly plant on a 177-acre tract at Mahwah, costing approximately $25,000,000, with an expenditure of almost that much more to equip the plant.

Local industries include the Aluminum Company of America, Allied Chemical and Dye Corporation, Lever Brothers, Curtiss-Wright, Bendix Aviation, Continental Paper Company, American Brake Shoe Company, Watson Elevator, and Prentice-Hall Publishing Company.

How It Started

Even before the outbreak of World War II, R. H. Macy and Company cast eyes upon the growing retail possibilities of the burgeoning North Jersey market. In the early 1940's, Macy's acquired a tract of land in Hackensack, one block off Main Street's shopping district. After holding it for several years, the company subsequently sold the property, concluding there was greater potential in a properly located and designed regional shopping center in the Bergen-County area, than in a more limited site in the center of county seat Hackensack.

In 1947 N. T. Hegeman Company, a real estate development firm that owned fifty acres with almost a mile of frontage on both sides

of State Highway Route 4, Paramus, outside of Hackensack, announced plans to develop a regional shopping center. Extended negotiations took place with Allied Stores Corporation and R. H. Macy and Company to induce them to take the branch department store to be the main unit in the center. Although several national chains and numerous local merchants expressed interest in going into the project, the developer's inability to induce Macy's or Allied Stores to come in resulted in a decision not to go ahead at that time. It is believed that the decision of the two department store chains not to participate was based in part on the fact that the tract was not considered large enough for a regional center.

The following year, 1948, another group, National Suburban Centers of Boston, publicized plans to construct a regional shopping center on a 200-acre tract in Paramus, not having frontage on any major highway, but being accessible from Routes 4 and 17 nearby. These investors constructed the Shoppers World at Framingham, Mass. This firm, which had a branch of Jordan Marsh Company, an Allied Stores subsidiary, as the department store in its Framingham project, made strenuous efforts to induce Allied Stores to come into its Paramus project, but without success. Although National Suburban Centers induced Paramus to re-zone its property conditionally for commercial use, its project likewise failed to materialize.

In 1951, the Regional Plan Association of New York published a bulletin entitled "Suburban Branch Stores in the New York Metropolitan Region." This showed among other things that the Bergen County part of that region had only two branches of New York stores, both on Main Street in Hackensack, both selling wearing apparel only. In contrast, adjoining Essex County, N. J., had sixteen suburban branches of New York stores, Westchester County, N. Y., had eighteen and Nassau County, N. Y., had nineteen. This was indeed a graphic illustration of the retail under-development of Bergen County's rich area.

Meanwhile a race of sorts was shaping up between Macy's and Allied Stores for the assemblage of sites on Route 4 in Paramus for regional shopping centers.

In the summer of 1951 R. H. Macy and Company announced the assemblage, at the junction of Routes 4 and 17 in Paramus, of a fifty-

six-acre tract upon which, it was stated, would be constructed a large regional shopping center. This site has since been enlarged by later acquisitions to approximately 140 acres.

By the spring of 1952 Allied Stores completed the assemblage of its land containing 100 acres astride Route 4 in Paramus, about three-quarters of a mile east of Macy's location. It simultaneously disclosed its intention to build a huge regional retail center.

Announcement of these two proposed regional centers, each purportedly the largest in the United States, practically next door to one another, posed an unprecedented situation in retail merchandising. Large suburban store centers were successfully operated in many parts of the country. But never before had two of the largest merchandising organizations in America decided to develop two mammoth enterprises in the same suburban community.

Negotiations began between the two groups to explore the possibility of combining the two centers into one. After more than a year of such discussions, it was suddenly announced that both Macy's and Allied Stores would build their own projects, as originally intended.

Garden State Plaza

Macy-Bamberger's Garden State Plaza is strategically sited at the junction of Routes 4 and 17, the two principal traffic arteries in the county. Garden State Parkway, now in its final stages, will diagonally overpass Route 4, directly adjacent to the Macy site. An interchange between Garden State Parkway and Route 4 will permit access from the Parkway. Route 4 was widened at that point, with the addition of deceleration lanes existing on Route 4 where the Parkway ramp connects with Route 4.

The site contains approximately 140 acres, of which about ninety-two acres are intended for present development—remainder for future use. Present plans call for construction in four stages or clusters, each one except the last being centered around a major retail outlet. Four stages will total approximately 1.5 million square feet of rentable area.

The first group of stores, containing somewhat more than 750,000 square feet, will have as its nucleus a 340,000 square feet branch of L. Bamberger and Company, Macy's New Jersey division.

The second stage centering around a 75,000 square feet junior department store will add another 350,000 square feet to the project. The third stage will include a 200,000 square feet branch of a second major department store. The fourth stage, comprising another 125,000 square feet, will round out Garden State Plaza with a multi-story office and professional building with additional stores. Altogether, there will be about 120 stores.

Buildings will be grouped in a rectangular-shaped central area around an interior mall, with perimeter parking for 8400 cars. The great majority of the cars will be parked no more than 300 feet from a building or from the mall. All trucking, service, loading and unloading facilities will be underground. Additional features include all-weather canopied walks from store to store, year-round air conditioning, attractively landscaped approaches and grounds, dramatic night lighting for evening openings, a community auditorium, a variety of restaurants, and recreational facilities.

To insure proper internal traffic circulation, a carefully planned system of interior roads will distribute traffic smoothly from the highways to spacious parking areas. Facilities are also included for the handling of buses and bus passengers.

The ratio of parking space to sales area will range as high as 6.9 to 1 (that is, 6.9 cars per thousand square feet of rentable area to one square foot of retail sales area). This will vary with the four stages of construction of Garden State Plaza.

Since Paramus has no sewer system, the project will construct its own disposal plant.

Facts and statistics upon which Macy-Bamberger will base its investment in Garden State Plaza are:

1. A central location in a trading area, comprising about 900,000 people, which has experienced a 41 percent population growth since 1940 with no sign of leveling off. Comparably, during the same period the population increase in all of New Jersey has been 26 percent, and, countrywide, 22 percent.

2. Above-average income with an average trading area family income of $5600, as against a national average family income of $4570.

3. Rich sales potential. In 1955 total retail expenditures by residents of the area will approach one billion dollars. Population

growth alone will increase this at the rate of $25,000,000 a year. When Garden State Plaza is fully developed it is expected to do an annual sales volume of $87,500,000.

To help meet the expected traffic increase in peripheral streets and roads, Garden State Plaza has purchased the old public service trolley right-of-way to the south and with its own funds will use it for the construction of an additional important traffic artery.

It has also acquired sufficient frontage on the opposite side of Route 4 for the construction of an overpass, if this should be necessary. Because of this, and because of the full two-level clover-leaf intersection at the junction of Routes 4 and 17, anyone approaching Garden State Plaza from any direction may enter it by simple right-hand turns, thus avoiding dangerous left-hand turns against traffic.

The target date for starting construction at Garden State Plaza is the late summer of 1955. Barring unforeseen delays, the first stage should be completed for an expected opening in the late fall of 1956.

Bergen Mall

Allied Stores Corporation's Bergen Mall will occupy a site of 100 acres lying on both sides of Route 4, of which eighty-five acres are in Paramus, and fifteen acres in adjoining Maywood. In addition to its Route 4 frontage, four other access roads extend along its north, east, south and west sides. It will have forty-seven entrances and exits, of which thirteen will be on Route 4.

Carefully planned parking areas will have a total capacity of 8635 cars. Many entrances and exits will be important factors in facilitating the quick dispersal of traffic at peak periods.

Construction of Bergen Mall is planned in three phases, for a total of 1.5 million square feet of store and building area. When completed, the center will contain a 300,000 square feet branch of Stern Bros. (N.Y.) department store, with provision for expansion to 500,000 square feet; another branch of a major department store; 100 additional stores and shops; and two multi-story buildings, one to be a medical and dental center, and the other an office building.

The first phase of the project, to contain 860,000 square feet, is scheduled for commencement in the late summer of 1955, and should be completed a year and a half later.

The principal store cluster, encompassed in the first phase, is to be built as a rectangular group surrounding a two-level mall, the upper level to be pedestrian and the lower level to be a truck tunnel. Stern Brothers will be in the center; at one end will be another department store, and at another end a large variety store. Placement of the two largest and key units at opposite ends of the mall is intended to insure even circulation of shoppers throughout the project, and to avoid the dead spots so often found in improperly designed retail centers.

Principal parking areas, double-decked in places, are so laid out that the outlying portions will be well within 400 feet of the stores. Additional auxiliary areas will be provided for employee use and for peak holiday periods. The general overall ratio of parking space to sales area will be between three and four to one.

Bus transportation has not been overlooked. Recessed areas will be provided adjacent to main entrances and exits for the accommodation of bus passengers.

In the event an agreement cannot be reached between Bergen Mall and the Borough of Maywood to tie into the Maywood sewer, Bergen Mall will construct its own disposal plant. This presents no serious problem. All trucking and service facilities will be via underground tunnels.

The trading area or potential market of Bergen Mall is indicated by a map prepared by R. M. Chapin, Jr. By the use of shading, the entire Bergen Mall market has been divided into three zones, lying within a ten, twenty and forty minute drive of the center.

Bergen Mall market (40 minutes' driving time) is equivalent in population to Delaware, Nevada, Vermont, and New Hampshire combined. It contains 1,588,000 persons enjoying an annual income of $2,665,000,000, larger than the combined family income of Boston and Cincinnati. The potential market within ten minutes' driving time is 370,000 persons, with $700,000,000 annual income; within twenty minutes 850,000 persons with $1,500,000,000 yearly.

Ten-minutes' driving contains a market larger than Fort Worth, Texas, or Rochester, N.Y., or Albany, N.Y. and Hartford, Conn. combined. Within twenty minutes' drive of Bergen Mall are populations greater than Washington, D. C., San Francisco, Pittsburgh, or Houston, Texas.

FIGURE 1. Garden State Plaza Will Accommodate 8400 Cars.

FIGURE 2. Bergen Mall Will Have 47 Entrances and Exits.

Bergen Mall's trading area, as shown by Chapin, is growing at the rate of a city a year—a city the size of Miami Beach, Florida, or Tucson, Arizona. The Regional Plan Association of New York, in a recent study, showed that Bergen County alone may expect by 1975 an increase of 459,000 persons, or a rise of 71.6 percent over the present population.

The preparation of the Chapin map required the study of roads and road conditions, of traffic patterns, of six-, four-, and two-lane highways, and of timed road-driving tests. It shows the not too surprising results that places an equal air-line distance from the center are frequently in different time-driving zones.

That the area is a potential merchandising "uranium mine" is further indicated by figures for 1954, released by Sales Management Survey, showing that of 200 leading counties in the United States, Bergen is thirteenth in average family income, with $6,831 a family; twenty-eighth in population, but is 184th among those 200 counties in retail sales consummated within its borders. The most obvious reason for the great disparity between local income and local spending is the proximity of the county to New York City, Paterson, Jersey City, and Newark. With the establishment of the two huge regional centers, it is likely that the poles of the magnet will be reversed, and that the area will not only retain the major part of its own large purchasing power, but will draw off a considerable amount of business from the older traffic-congested cities surrounding it, including New York.

Problems and Proposed Solutions

Zoning. Garden State Plaza's 140-acre site lies in Paramus, part of it zoned "D" business and part "E" industrial. Either of these zoning classifications would permit construction and operation of a regional shopping center. Consequently R. H. Macy and Company has no zoning problem.

Of 100 acres forming the site of Bergen Mall, 85 acres are in the "E" industrial zone of Paramus, offering no obstacle in that regard. The other fifteen acres, in the adjoining Borough of Maywood, are zoned residential. Allied Stores applied to the Borough of Maywood for a rezoning of that portion of its property to permit its use for commercial development. It ran into determined opposition from a

Merchandising Potential Paramus Location

minor but vocal group of Maywood residents, many of whom live in the neighborhood of the fifteen-acre tract, and fear a depreciated value of their homes from the proximity of such a large retail center.

To overcome this opposition Allied Stores has proposed substantial concessions to Maywood, among them offers: (1) to build on the Maywood portion of its site a five-story, air-conditioned, medical and professional building that would return approximately $40,000 a year in taxes; (2) to depress the parking area in that vicinity several feet below grade, which with shrubbery plantings would screen out headlight glare and traffic noises; (3) to reduce its entrances and exits to Maywood streets to a minimum, and to confine service vehicle and trucking entrances and exits to Route 4 and other streets outside the Maywood line; (4) to contribute approximately $240,000 to Maywood to liquidate its sewer indebtedness in return for the right to connect to the Maywood sewer; (5) to pay for an additional fire engine, if necessary; (6) to provide its own private police force; and (7) to purchase at fair market value the homes of those Maywood residents wishing to sell, whose homes are on streets abutting the Maywood portion of its tract.

Allied Stores has stated that if the re-zoning in Maywood cannot be had, it will confine its project to the eighty-five acres in Paramus. This might entail a re-arrangement of its parking areas, with possibly some double-deck parking. In that event, it would use the Maywood part of its site for the construction of homes to be rented or sold to employees at Bergen Mall.

Maywood's zoning problem has not been resolved, although a majority of the borough council has indicated that it favors the re-zoning. This would certainly seem to be the better part of common sense, since the advantages offered to Maywood are considerable. Re-zoning or no re-zoning, Maywood would still have problems associated with the proximity to a large development.

Fear that nearness to a large retail center automatically brings about depreciation in home-value is by no means borne out by facts. While diverse factors enter into the result, experience has generally been that homes in the vicinity of well-designed and properly planned shopping centers have actually increased in value.

The latest illustration of that point is contained in a publication entitled, "Changes in Westchester," issued in January 1955 by the

Westchester County (N.Y.) Department of Planning. A study was made of the effect upon neighboring home values of the construction of Ridgeway Shopping Center, in nearby Stamford, Conn. The builder of this attractive and successful $6,700,000 center containing more than thirty stores, a theatre and professional offices, with parking for 1100 cars, had to overcome bitter opposition from his residential neighbors before the necessary re-zoning was granted in 1946.

Today sentiment toward the shopping center has been reversed. Eighty-six percent of those living nearby now like it for a number of reasons, including shopping convenience, ease of parking and variety of merchandise available.

To determine the effect of the Ridgeway Center upon adjacent property values, an analysis was made of prices paid for homes since 1943, when plans for the center were first announced. An index of property values was computed for the residential area around Ridgeway, and another index for a comparable area in another part of Stamford. Graphs prepared from the price analysis showed that home values in the Ridgeway vicinity have had a greater increase than in the other neighborhood.

In addition, Stamford will collect from Ridgeway in the current fiscal year $69,000 in real and personal property taxes as compared to $2,376 before the land was developed. If the site had been devoted to single family homes, the municipal expense to the city would have been much greater, and the tax yield much less.

The Westchester County Department of Planning sums up the relationship between property values, taxes and planned shopping centers as follows:

> "The fundamental question is whether the shopping center is more efficient as a place to buy and as a place to work than the common alternative—a row of miscellaneous stores and eating places lining both sides of a busy street. There can be little doubt that putting a variety of attractive stores in one place, with enough parking space, makes more sense than scattering them along a stretch of a mile or more. Consolidation helps traffic move, saves gas and wear on the consumers' automobiles, reduces shopping time, lowers the cost of city services and increases tax receipts."

Plans of the Port of New York Authority. On January 17, 1955, the Port of New York Authority and the Triborough Bridge and Tun-

nel Authority jointly announced a vast five-year program, to cost $577,000,000, for new bridge and arterial highway construction in the New York-New Jersey metropolitan area. Its purpose was to relieve traffic strangulation in the metropolitan area, and to provide by-pass routes around Manhattan for through-traffic between New England and the South.

The part of that far-reaching program affecting the Bergen County area includes the following: (1) adding a second deck to the George Washington Bridge to provide six additional traffic lanes, with new approaches at the New York and New Jersey ends of the bridge, $88,000,000; (2) constructing a new Bergen County expressway from the George Washington Bridge to Route 46 in Clifton, N. J., $60,000,000, to take the increasing volume of through-traffic off local Bergen County roads; (3) extension of the New Jersey Turnpike from its present northern terminus near the George Washington Bridge to the New York state line where it will connect with a spur from the New York Thruway, $60,000,000; (4) extension of the Garden State Parkway from its northern end at Paramus to the New York line to connect with an interchange of the New York Thruway, $25,000,000; (5) the widening of N. J. Routes 4 and 17, and U.S. Route 46, and completion of N. J. Route 208, $25,000,000.

This program, when completed, will materially help some of the traffic problems generated by Bergen Mall and Garden State Plaza. The widening of Routes 4 and 17 will particularly benefit peak traffic loads coming to and from the centers in their immediate vicinity. The extension of the Garden State Parkway and the New Jersey Turnpike to meet the New York Thruway will greatly enhance the value of those toll highways to the regional centers and will broaden their trading area. The double-decking of the George Washington Bridge, with new and improved bridge approaches, will make the centers more accessible to the 1,275,000 motor car owners in New York City who might like to use their cars on shopping trips but find it inconvenient to do so in New York.

The cost of the addition and the connection to bridge will be borne by the Port of New York Authority because Bergen County is an integral part of the vast New York metropolitan highway complex. Other financing will come from Federal and state funds. It is fortunate indeed that the funds will be available from that source,

because if these improvements had to depend upon state or local tax revenues for their construction, they would be many years acoming.

Mass Transportation. Paramus has no rail facilities at all. Bus service is the only mass transportation in the immediate vicinity of these two centers.

The site of Garden State Plaza has presently only a few residents within reasonable walking distance. All of its customers will arrive either by automobile or bus. Bergen Mall, with the exception of a sprinkling of one-family homes adjacent to that part of its site lying in Maywood, is in the same situation. Both of these regional centers will depend therefore exclusively upon vehicular traffic.

The present bus service along Routes 4 and 17, the main arteries serving these centers, is sparse and infrequent. It seems certain that the two centers will require a considerable increase and improvement in bus transportation over the existing facilities.

Municipal Zoning and Off-street Parking Requirements. Paramus was until the end of World War II predominantly rural. It had no central business area other than the comparatively few business places on Routes 4 and 17, mostly gasoline stations and restaurants.

With the end of the war, however, the town, like so many others, entered a new phase in its growth. Its nearness to New York City and other cities of the North Jersey area, with the availability of its large open spaces, engendered a building boom, mostly of moderately priced one-family homes.

Several small neighborhood groups of stores arose in various parts of town, but most of the post-war business and industrial development occurred along Routes 4 and 17. For almost five miles through Paramus, there has been a rapid growth along these heavily-traveled arteries of retail and industrial establishments.

In 1946 the mayor and council of Paramus were sufficiently far-sighted to adopt a comprehensive zoning plan. Amended from time to time to meet changing conditions it is presently about to be revised again. While the rapidly expanding town has had its share of growing pains, the enactment of the zoning ordinance and setting up a planning board, plus the more recent services of professional

town planning consultants, has spared it many of the municipal headaches of older communities.

Bergen County, with its seventy municipalities, is the first New Jersey county to be 100 percent zoned. Fifty-eight of its municipalities have also established planning boards.

All of these steps are helpful on the local level, but the field is wide open for regional planning and municipal co-operation on a county-wide level. Developers sought re-zoning to set up business areas on the borders of certain towns, directly adjacent to high-class residential neighborhoods in adjoining towns. In a case decided not long ago the New Jersey Supreme Court held that a municipality which would be adversely affected by such a development in an adjoining town could invoke the aid of the courts to prevent it.

Other problems are exemplified by towns like Teterboro and South Hackensack, devoted mainly to industrial plants and having comparatively small residential areas. This results in a low tax rate as compared to other municipalities in the county which have little or no business and industry and, being almost exclusively residential, have high tax rates. This inequity is brought about in part by their having to educate the children of people living in the residential towns but working in the industrial towns. The situation clearly calls for a redistribution among the municipalities, not only of tax revenues but of governmental responsibilities.

An experiment of this kind, initiated in Canada two years ago by the city of Toronto and twelve of its suburban townships, has helped to ameliorate or solve many vexing problems caused by the interchange of people and industry between city and suburbs.

A good start in that direction also was the creation several years ago of the Bergen County Sewer Authority, a quasi-governmental body, to solve the sewer problems of the various municipalities on a county-wide basis. A part of its program has already been completed, and progress is being made on the remainder.

The Paramus Zoning Ordinance of 1946 contained certain off-street parking provisions, but its requirements for business and industrial districts were vague: "Adaequate parking space to accommodate the normal number of automobiles which shall congregate shall be provided."

Most of the new business and industrial buildings along Routes 4 and 17 do have adequate parking areas, but the lack of specific off-street parking standards has created a small number of retail buildings on the highways, with too much lot coverage and woefully inadequate parking space. The result has been shoulder parking on highways, parking on other people's property, traffic congestion and an increased accident rate.

To correct this situation the mayor and council of Paramus are preparing to enact a much more comprehensive and specific off-street parking and loading ordinance. The Paramus Chamber of Commerce recognizes that adequate off-street parking is the one great advantage that Paramus can offer over the older communities and has urged an off-street parking and loading ordinance setting up proper minimum standards.

As an example, the neighboring town of Fairlawn built up its Route 4 business area several years ago with wholly inadequate parking facilities. Fairlawn, in a heroic attempt to correct past mistakes, now has an off-street parking ordinance. But it came too late to prevent the lack of proper on-site parking in a large part of its retail business area.

Local Attitude Toward Centers. How do people living and doing business in the area feel about their new neighbors? The answer has as many facets as there are local interests involved.

Paramus, where the centers are to be built, has issued an unqualified welcome. The reasons are not hard to find. No Paramus residents live anywhere within walking distance of either Garden State Plaza or Bergen Mall who might justifiably—or otherwise—claim that the shopping centers will mean a change in the residential character of a neighborhood.

The principal business and industrial areas in Paramus are along Routes 4 and 17. Business men along these main arteries believe that the two centers on those highways, because of their great drawing power, will improve the prospects of business already there. Neighborhood stores in other parts of town sell mostly convenience-goods to residents in their own areas, and are not particularly perturbed.

The Paramus mayor and council as well as the local business community and residents look forward to the large increase in tax ratables which would accrue to the town from the centers. It is anticipated that, after allowing for necessary municipal services, a large net tax revenue will remain to the town toward paying for much-needed present and future expansion in educational and other services of the borough.

Effect Upon Older Retail Centers. The establishment in one area of the two largest regional shopping centers in the country poses a double-barreled threat to present retail districts in cities and towns of Bergen, Passaic, Hudson, and Essex Counties.

Understandably, the prospect has disturbed some of the older merchants, and some of the municipalities obtaining much of their tax revenues from their central business districts. On the other hand, it has spurred plans for increased off-street parking facilities and better traffic control for central business districts, which previously had been accumulating dust on some shelf.

Hackensack, Teaneck, Englewood, Bergenfield and Fairlawn, among others, have added and are continuing to add significantly to their municipal off-street parking areas; they have metered some of their curb parking, and have generally taken steps to speed traffic movement in their business districts.

The reaction of established retailers has ranged from an attitude of "It won't hurt us, it will help us," to one of despondency and gloom. To settle some doubts agitating many Bergen County retailers and residents, and to throw much-needed light on what effects regional shopping centers have on established retail districts and adjacent residential areas, the enterprising Bergen Evening Record, in November 1954, sent its executive editor on an 8000-mile trip around the United States to study the nation's largest regional shopping centers.

Among the centers visited were: Northgate, in Seattle; Stonestown, in San Francisco; Westgate, in suburban Cleveland; Northland, in suburban Detroit; Shoppers World, in Framingham, Mass., and Cross County, in Yonkers, N.Y. The result was an illuminating series of articles describing the various centers and their surrounding

areas, and analyzing their impact upon downtown big-city retailers, as well as upon residential and commercial property values in their more immediate localities.

Some of these regional centers were too new to afford sufficient data for accurate estimate. Nevertheless, the cumulative findings pointed to these general conclusions:

(1) A well-planned and integrated regional center, adequately financed, is a distinct asset to its community.

(2) Initial opposition from nearby residents soon turned to enthusiastic acceptance.

(3) Adjacent residential property values increased considerably over comparable areas elsewhere.

(4) Regional centers yield much more in taxes to a community than they require in municipal services.

(5) Insufficient integration with local streets and roads may increase traffic congestion.

(6) Existing retail trade generally does not suffer permanent harm, although inefficient retailers may be hurt, thus separating the merchants from the mere storekeepers.

(7) Competition is sharpened, forcing main street and big-city retailers to improve store appearance and take other indicated measures to keep their trade.

(8) The rapidly expanding economy of areas in which the regional centers locate assures enough business for both new and old retail districts.

(9) Regional centers attract additional business to their areas, some of which spills over to local merchants.

As the Bergen Record sums it up: "Two observations seem to be almost universal: the alert, aggressive merchants prosper, shopping center or not; the ones who stagnate find the shopping center a convenient excuse . . . Whatever its successes or failures, its advantages or shortcomings, the shopping center is the modern trend in retail merchandising because it provides what Main Street lacks—room."

The ultimate impact of Bergen Mall and Garden State Plaza

upon older retail districts will depend upon many factors. Not the least of these will be the steps taken by the region's cities, towns, and merchants to halt and reverse self-strangulation and hardening of the traffic arteries which produced regional shopping centers in the first place. If they will stop putting off the evil day and take what seems to be the expensive way of making their goods and services accessible to customers, they will not lack for business and need not unduly fear competition from any source.

The next five years in Paramus and in Bergen County should be interesting and exciting years. Transforming meadow and woodland into huge, attractive arrays of stores, shops and offices to serve the needs of thousands of persons daily, in casual and unhurried manner, will be something indeed worth seeing. It will be good to be around then.

Traffic Planning for the Capital of Switzerland Is Complicated

DR. KURT LEIBBRAND

Dr. Leibbrand, Professor of Railway and Transportation Engineering at the Swiss Federal Institute of Technology, has served as consultant to more than twenty cities. He has assisted in the preparation of metropolitan master plans and in the planning of railway and street systems. Dr. Leibbrand has also given lectures on traffic engineering in Germany, Austria, the Netherlands, and Italy. In the July 1952 issue of the Traffic Quarterly *he reported on "Traffic Engineering in Switzerland."*

BERN, the capital of Switzerland, is a charming old city of 150,000 inhabitants. It lies high over the Aare river in a beautiful setting to which the world-famous Bernese Alps form a background. The central district, known as the Altstadt or "old city," has maintained its medieval appearance throughout the centuries, and the citizens are anxious to preserve the picturesque beauty of antiquity.

The conflicting requirements of an efficient traffic system and the maintenance of medieval charm pose difficult problems for the traffic planner. He must work within an anachronistic framework in which modern traffic passes through gothic gateways, around lovely old fountains, through narrow streets which may not be widened.

Although the population of Bern is small by American standards, it is densely concentrated in a relatively small area. The approaches to the central business district from the southern, eastern, and northern suburbs lead over long, high bridges, and the city traffic focuses at the railway terminal on the western side of the Altstadt. In front of the railway terminal are two "platae," or squares, Bubenbergplatz and Bahnhofplatz. In this vicinity, the traffic problem is particularly severe.

During the years 1946–1948, Boutet, Walther and Miescher studied the feasibility of moving the railway terminal some 600 yards to the west to relieve the situation. They found that such a solution was inadvisable because the distance between the Altstadt

and the terminal would become too great. In 1950, a Swiss contest was held for the architectural design of a new terminal building, and for traffic regulation in the surrounding district. In 1952, the city authorities, acting with the Swiss Federal Railways, the Post Administration and the government of the canton (state), requested Dr. Walther, professor of business economy at the University of Bern, along with the author and Mr. Jaussi, a well-known architect of Bern, to prepare a traffic plan.

Extent of the Planning

It soon became apparent that a general study of the traffic problems of the entire city would be necessary, and that the survey could not be confined to the immediate neighborhood of the railway terminal. The two squares in front of the terminal building could not be treated as separate units since they form a part of the traffic system of the entire central business district.

The period of time for which the results of a planning study are valid should of course be as long as possible. However, it takes many years to realize these results and all the while the technical development of all means of transportation continues at a rapid rate. In addition, it is difficult to make reliable estimates of the future population and of the trends in the field of traffic for a period of more than one generation.

Since the problem of the period of validity is basic for all other decisions, it requires careful attention. A period of 25–30 years seems appropriate, so the plan was prepared to apply to conditions which are expected to prevail until 1980.

The volume of traffic depends on the population and on the number of rides per capita. Considerable data from various statistical sources were evaluated to obtain the most accurate figures possible.

The volume of public transit is as follows:

1950: 156,000 inhabitants with 282 rides per capita and an average ride length of 2.3 km or 1.5 miles, giving a total of 100 million passenger kilometers or 63 million passenger miles.

1980: 230,000 inhabitants with 320 rides per capita and an

average ride length of 2.7 km or 1.7 miles, giving a total of 200 million passenger miles.

By 1980, public transit by street car and bus will increase by 100 percent.

Volume of Traffic

It is not expected that the rapidly growing number of motor vehicles will result in a decline of the number of public transit rides per capita. Since the end of the war the number of motor vehicles in Switzerland has more than doubled, but at the same time there was a marked increase in the use of public transit facilities. It is expected that this trend will continue. People who own cars will no longer use the public transit provided there is sufficient parking space. However, in a growing city, distances increase and many people who now walk from home to work will drive in the future. The construction of new suburbs will not only entail more rides, but longer ones as well.

Private traffic will probably increase much more than public transit. In September, 1952, there were 11,200 motor cars and 3,700 motor cycles, or a total of nearly 15,000 vehicles within the city limits of Bern. It is estimated that in 1980 a population of 250,000 will own over 40,000 motor vehicles. The public transit system of Bern and the street system of the Altstadt will have to cope with a doubled public transit volume and a more than three-fold private traffic.

The public transit authority and the city police were asked to carry out very detailed traffic counts. Their program was set up in close cooperation with the experts in order to avoid unnecessary counts, speed up the calculations, and reduce the cost of the surveys.

In 1951, the public transit carried about 48 million passengers, the daily average being 132,000 rides. It is necessary to have an accurate knowledge of the origin and destination of the flow of passengers. A special method of representative counting was developed which proved to be highly satisfactory. The counts showed the paramount importance of the street car and bus stop at the railway station. (See Figure 1.) The city police also made very careful counts of the private traffic within the Altstadt. In particular, the number of parked vehicles within this area was checked several times.

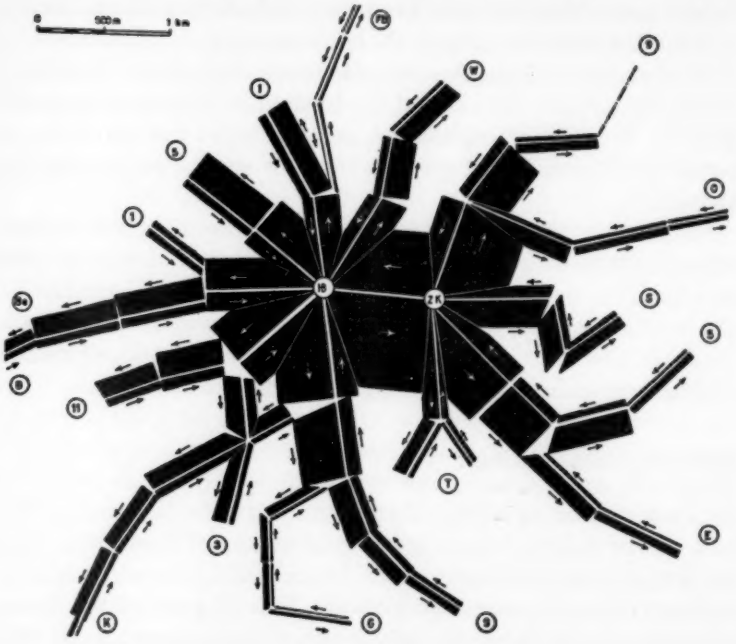


FIGURE 1. Passenger frequencies on the city transit lines at noon (rush hour) on November 25, 1952. Numbers mark street-car lines, letters mark bus and trolley-bus lines. HB = Bubenbergplatz, ZK = Zeitglocken Tower.

In Bern, the center of the business district and the focal point of the transit system do not coincide. The business district is bounded by the famous Zeitglocken tower in the east and the Bubenbergplatz in the west. The transit system, however, suffers a basic disadvantage because it focuses at the Bubenbergplatz.

The public transit lines essentially form a radial network. Only three street car lines, numbers 1, 5 and 9, pass diagonally through the city, while the remaining two lines and all of the ten bus lines turn at Bubenbergplatz. By this peculiarity of the network, the radial lines from the east lose many passengers at the Zeitglocken tower, but take on very few additional passengers and pass on to Bubenbergplatz half empty. Street cars and buses from the western radial lines are emptied completely at Bubenbergplatz before reach-

ing the central business district, since people do not like to change for the additional short trip to the business center.

The result is a large flow of pedestrians through the congested streets and narrow sidewalks of the inner city. This is an unsound situation from the transportation point of view, and could be removed by an extension of the lines from the west to the heart of the Altstadt.

The counts also disclosed that a genuine diagonal traffic already exists. In the growing city where people from the western suburbs work in the eastern part of the city and vice versa, the diagonal traffic will increase. A complete change from the existing radial network to a diagonal network is considered to be an absolute necessity. Such a change would have the following far-reaching consequences.

Operating considerations:

These will be adversely affected insofar as schedules in the Altstadt will be followed more precisely along radial lines than along the diagonal lines. Street cars or buses making turns remain at passenger stops for extended periods. This is particularly disadvantageous in the inner city where space is at a premium. If two radial lines are connected to form one diagonal line, it is possible to eliminate one turning stop of each of the two lines. The amount of waiting time in the round trip will thereby be reduced, and the vehicles will be used more economically.

Traffic:

The number of passengers getting off or transferring at Bubenbergplatz is extremely large. These passengers walk across the square in all directions, take up a great deal of space, and disturb the flow of vehicles. From the results of the traffic counts of the city authorities mentioned above, it was estimated that the introduction of diagonal lines would increase the number of through-passengers by at least 36 percent. The diagonal lines will bring new and faster connections, resulting in more passengers and more revenue. The pedestrian will prefer to ride if he is no longer forced to change. The "pedestrian competition" will be reduced and the congestion of the side-

walk will be relieved. At the same time the walking distance between the stops of the different lines on the Bubenbergplatz will be reduced from as much as 250 yards to no more than 60 yards, the average decreasing from 60 to 26 yards.

Miscellaneous:

The existing laws requiring the city transit authority to balance its revenue and expenses should not be enforced in its strict sense in the future. A careful calculation will be necessary to determine which expense increases are due to common traffic development, and the public transit authority should not have to pay for these.

By chance the number of lines leading from Bubenbergplatz to the west is the same as the number of lines to the north and east. There are several possible ways to connect the radial lines and transform them into diagonal lines. Two such combinations have been studied: one with nine diagonal lines and a second one with eight diagonal lines and two remaining radial lines.

Within the next few years, it will be necessary to scrap the half-century old, two-axled street cars which constitute a sizeable fraction of the total street-car fleet. It is very important to know whether they will be replaced by new street cars or whether buses will be preferred. In addition to the outmoded two-axled street cars there are twenty up-to-date cars with motors (of which fifteen are standard cars) and sixteen trailers (of which ten are standard cars), all of which have four axles.

Street Car or Bus?

The replacement of street cars by buses will change the layout of Bubenbergplatz. Therefore it was necessary to decide which means of transport will be used on all the public transit lines in the future. The advantages and disadvantages of street cars and buses with respect to vehicle operation, and the layout of streets and intersections are well known. However, the economic factor is the decisive one.

Careful calculations were made to check the economy of each line. Under existing conditions only two street-car lines are to be preferred to buses from the economic point of view. This situation

might be due to the fact that under the conditions which obtained for these calculations, different rolling stock was used on different lines. The calculations were adjusted for the case in which standard rolling stock was used on all street-car lines. In this case, too, three of the five street car lines should be changed from street car to bus operation.

Greater patronage means better economy for street-car lines. As a result of the over-all increase of traffic volume, it is possible that a line changed to bus operation will have to be switched back to street-car operation at a later date. However, the statistical data of the city planning office revealed that just those street-car lines whose change to bus operation is proposed will expect the poorest increase in patronage. Consequently the probability of a reversion to street-car operation is small.

Two street-car lines will remain in the future. They form a big cross which will be the backbone of public transit. All other lines will be operated by bus or trolley bus. The time of the change is to be chosen according to the technical and economic state of cars and tracks. The standard rolling stock is sufficient for operating the remaining street car-cross.

Trial runs of diagonal bus lines should start soon to get experience. Several lines are to be operated by one-man buses, the rest by two-man buses. Further studies in this regard are necessary. However, there will be no great difficulty, for in any case radial lines of equal load can be combined. Furthermore, this question is of no importance for the layout of the street system.

Principles for the Street Network

Efficiency and safety on a given road are highest if it is subject only to uniform traffic flow. It is therefore desirable to separate the following kinds of traffic.

a. Regional and local traffic.

b. Public transit and private traffic.

c. Motor and non-motor traffic (including bicycles.)

d. Traffic in different directions (one-way streets and grade separations.)

e. Moving and parking vehicles.

These principles have been applied as far as possible in the layout of the street system of the city of Bern.

The first step in relieving the traffic congestion of the inner city, especially near the railway terminal, should be the systematic deviation of all but local traffic. After that, only the remaining traffic needs to be regulated.

In 1933 a Swiss contest resulted in recommendations for a system of center ring and deviation streets in the outskirts of Bern. Since then, these streets have been planned and partly built. In the meantime, however, street traffic has developed in an unexpected manner. Large-scale traffic counts of the Swiss "Oberbauinspektorat" (Federal street authority) have confirmed, contrary to common opinion, that the fraction of through-traffic in great cities is a very small one. The destination of most cars is the city of Bern itself.

A street pattern in keeping with the traffic bound for the city and the traffic between the suburbs will meet the demand better than will new outer ring streets. In addition, economic considerations discourage the construction of more deviations. Certainly one mile of an outer ring is cheaper than one mile of a new street in the inner city where real estate is much more expensive. The length of the outer ring, however, is usually much greater. While the cost of a relatively short street or break-through for relieving the highly congested area is extraordinarily high, the total cost of the outer ring may well be even higher.

On the other hand, there is one point of special importance. If the connections of the new street are strategically chosen, very close to the focal points of the city traffic, they will exert a much greater effect on the traffic picture than a street at the city's periphery. If a street takes a doubled or trebled traffic volume, it is reasonable to spend two or three times more money for its construction.

Tangents' Triangle

A solution to the problem of congestion in the central business district is provided by a great street triangle. This would consist of three tangent streets just outside the Altstadt which will attract all through-traffic and let it pass around the focal zone of Bubenbergplatz and Bahnhofplatz. (See Fig. 2).

FIGURE 2. Main traffic arteries of the city of Bern. The Tangents' Triangle will relieve traffic congestion in the Altstadt (central business district.) The dotted part of the Western Tangent does not yet exist, but will be of paramount importance.

The Southern Tangent leads from Eigerplatz to Thunplatz and crosses the Aare river over a new bridge, the Gaswerkbrücke. The Eastern Tangent begins at the Thunplatz and follows the small existing streets to the Schützenmatte. In the future there should be two lanes in each direction.

The construction of the Western Tangent will be very difficult, but this tangent is expected to be the most effective branch of the triangle in relieving traffic congestion. It will fulfill the following requirements:

1. A new throughway without level crossings for all regional and through-traffic around the focal points.

2. A passage around Bubenbergplatz which could be used in emergencies by city traffic.

3. An access to the new main post offices and to the new parking lot on the roof of the railway station.

A count of motor vehicle traffic during the peak hour from 11:30 to 12:30 was checked to calculate the probable future efficiency of the Western Tangent. At present, the new connection would normally be used by 300 motor vehicles in each direction. The traffic in Bubenbergplatz would be reduced by almost one-third while the traffic from Bahnhofplatz and Bollwerk would be reduced by two-thirds.

During the rush hours when the large parking lot empties or fills there will be a considerable addition to the normal flow of the tangent. Statistical evidence gathered from other large parking lots indicates that during peak times as many as 80 percent of the parked cars leave (at the beginning, say, of the noon hour) or enter (at the end of the noon hour) within a 20-minute period. Thus, in this period, 80 percent of the 425 cars parked in the lot—about 320 cars —will be added to the normal flow. Half will go in each direction, so that during the rush hour there will be almost 500 cars traveling in each direction on the Western Tangent.

If motor traffic increases by more than 200 percent during the next twenty to thirty years, it is possible that a two-lane road will no longer be sufficient. Space should therefore be reserved for an even-

ness district.) The dotted part of the Western Tangent does not yet exist, but will be of paramount importance.

tual widening of the road to four lanes. It is of course important that no permanent structures be erected on the reserved space.

Details of the Western Tangent

At first glance, the southern approach to the Western Tangent seems to be superfluous since another approach from the west may be built more easily. However, the connection from the Eigerplatz to such a western approach is about 600 yards longer. The proposed Western Tangent has a length of one mile. The western approach would bring about a traffic loss of about 30 percent, thus reducing considerably the value of the tangent. The southern approach is therefore of prime importance.

The present time is favorable for the construction of the southern ramp. The city authorities have already decided to tear down the existing buildings, and the plans for new buildings are well under way. The southern ramp will have an incline of 6 percent and may be designed to suit its environment.

The central part of the Western Tangent must cross the railway tracks on both sides of the station. At first it was proposed to accomplish this by constructing a tunnel under the tracks. In addition to the high construction costs, operating expenses would be large because of the problems of adequate light and air circulation. It was therefore decided that a long bridge having convenient access to the parking lot would be more appropriate.

The northern approach is shown in Figures 4 and 5. At the Schützenmatte there is a grade separation and the Eastern Tangent lies in the second level under the Western Tangent. At a later date, a second approach more to the north may be built to get a direct connection to the northern suburbs.

Public Transit Axis

The separation of public transit and private traffic will speed up traffic flow for both kinds of transportation. Since public transit vehicles have to make regular stops to pick up and discharge passengers, their speed is less than that of private cars. Private traffic is disturbed if a street-car stops in the middle of the street and pas-

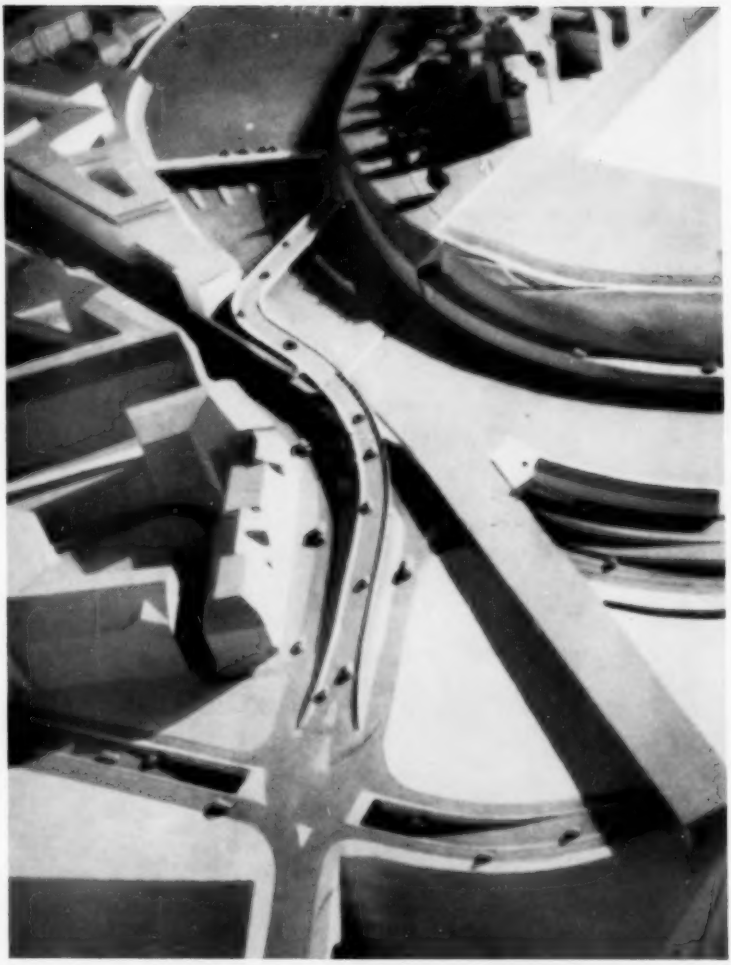


FIGURE 3. The northern ramp of the Western Tangent seen from the north. In the foreground is the grade separation of Eastern and Western Tangent. In the background lies the great parking lot over the railway platforms. The tracks which are not marked turn to the right-hand side.

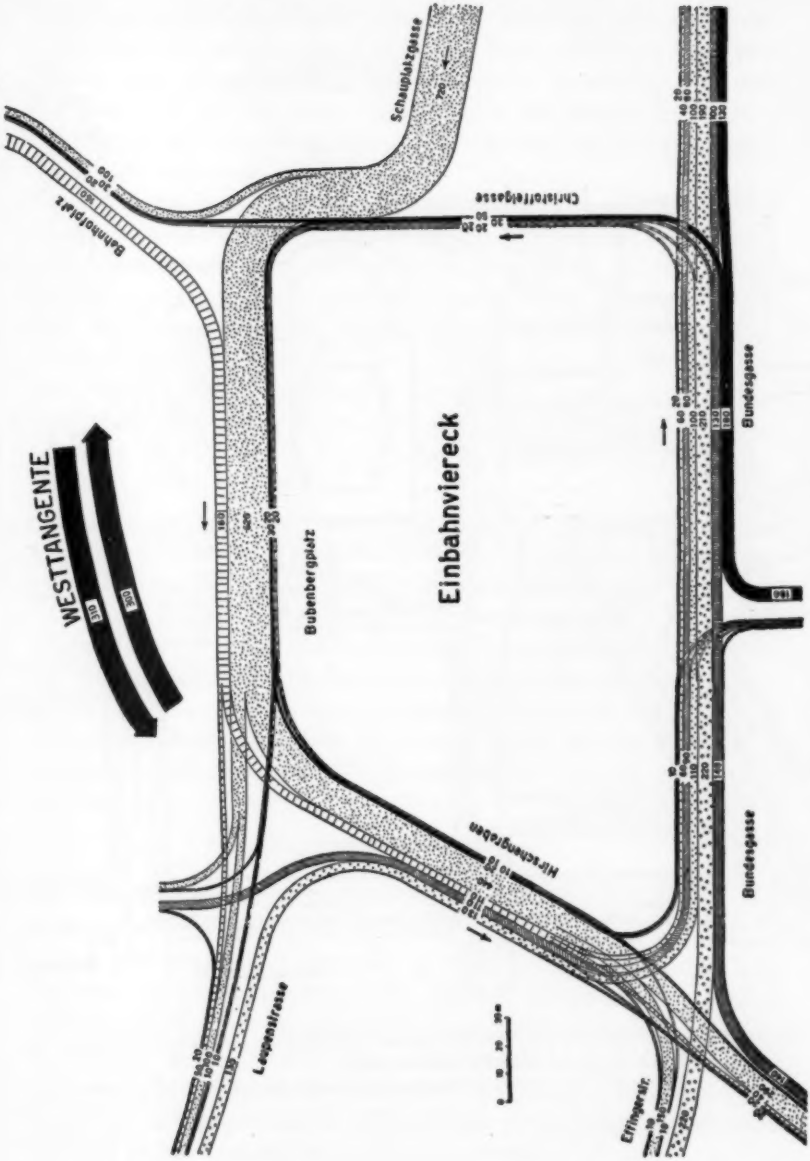


FIGURE 4. Future distribution of the traffic flow.

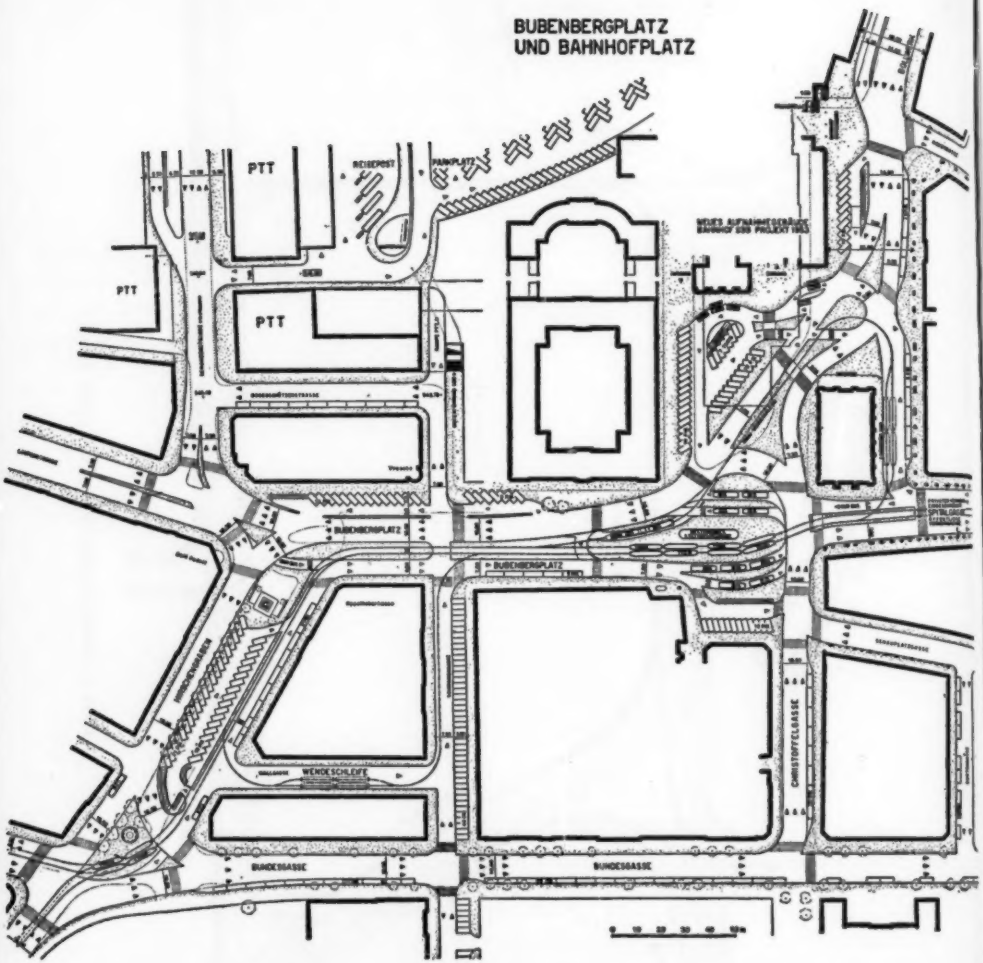


FIGURE 5. Bubenbergplatz with its one-way system and central public transit station.
Black arrows = lanes for private traffic
White arrows = lanes for buses and delivery service only

sengers cross the road. It is also disturbed every time a bus leaves the traffic flow to reach its stop, clogs a full lane during the stop, and weaves back into the traffic flow afterwards. Following a recommendation of the city police authority, it was decided to concentrate all public transit vehicles on one street, leaving all other streets for private traffic only.

The public transit axis is very conveniently situated right in the center of the Altstadt. All parts of the business district lie within a short distance of the street car and bus stops. Six diagonal lines, consisting of two street-car and four bus lines will pass through the axis. Congestion of the axis will not occur. Even if during rush hours all six lines are operated with three-minute headways, there will be an average headway of thirty seconds which is sufficient. On one lane or at one stopping place, as many as 120 street cars with trailers or buses can be accommodated without difficulty. This has been demonstrated in several other European cities.

The introduction of the public transit axis does not mean that private traffic is to be completely excluded from the streets concerned. To the extent that public transit is not disturbed, delivery of goods and cars belonging to residents of the street will be permitted. The diversion of all other traffic will be achieved not only by traffic signs but also by the layout of streets and intersections. In particular, there will be an intentionally unfavorable entrance and exit at the Bubenbergplatz. It is to be expected that the public transit axis will thereby tend to become a street for pedestrians and for shops.

Separation of Directions

The introduction of one-way streets generally results in higher efficiency and capacity, especially at intersections. Over a 24-hour period, the total flow is normally the same in both directions. It is therefore preferable to arrange the one-way system in pairs. Streets used in one direction during several hours and in the other direction for the rest of the day are dangerous, difficult to provide with adequate signals, and not to be recommended. A one-way system already operating in one part of the Altstadt has proved highly successful and will be incorporated in the future network.

A schematic pattern of one-way streets in which all streets north

of the public transit axis are used in westerly direction and the streets south of the axis in easterly direction is not desirable. Such an arrangement would bring about a sharp rise in the volume of transverse traffic which would cross and unnecessarily interfere with the public transit.

The Bubenbergplatz Quadrangle

The most important part of the one-way system is the one-way quadrangle formed by Bubenbergplatz, Hirschengraben, Bundesgasse and Christoffelgasse (See Figure 4.) Private vehicles will pass around the quadrangle counterclockwise. The changes in the traffic flow may be seen in Figures 4 and 5. Calculations indicate that after the introduction of the one-way system and the opening of the Western Tangent, the capacity of Bubenbergplatz and Bahnhofplatz will be four times that of today.

Traffic counts showed that even after diagonal lines are introduced, many people will have to transfer at Bubenbergplatz. It is important that these passengers do not cross the lanes of private traffic. All street cars, buses and trolley buses will therefore be concentrated in a central station. The street-car tracks are to lie in the center of the station and the bus stops will be situated on both sides. The existing station building will remain unchanged, and tracks for turning street cars will be located on both sides of the station. Details are shown in Figure 5. The inner side of the one-way square will contain as many parking places as possible. Lanes reserved for buses will be designated by a colored concrete or asphalt coat.

Bahnhofplatz

Northeast of the Bubenbergplatz (Figure 5) lies the Bahnhofplatz. This square cannot be widened since it is encircled by a beautiful church on the east, the new railway station building on the north, and a famous eighteenth century hospital on the west. The square is divided into two parts, the southeastern part which has four lanes for private traffic, and the northwestern part having parking places for taxis and a small number of private cars.

From the financial point of view, it is necessary that any revision

of the layout of the Bahnhofplatz be done in several stages. The Platz may at no time be closed to traffic. Fortunately, the physical layout is such that a revision in several stages will be possible.

Kornhausplatz-Casinoplatz

Kornhausplatz and Casinoplatz are situated along the Eastern Tangent where traffic must pass through a lovely section of the Altstadt containing narrow streets, arcaded sidewalks, and the famous Zeitglocken tower. Since the Eastern Tangent should have two lanes in each direction, the stopping places of the public transit vehicles are to be transferred from these two squares to the public transit axis. It is very difficult to get enough space for the lanes, tracks and pedestrian crossings, and in several places the turning radii are very small. It is, however, forbidden to alter as much as a single stone of the old buildings.

Since underground construction is very expensive, it is to be avoided whenever possible. When it is unavoidable, the question arises of assigning traffic to various levels. If the underground passes are short, motor vehicles are more appropriate since they are more flexible and take steeper grades. If the passes are long, the street cars should use them since problems of air and light are simpler.

At the Bubenbergplatz, the underground level should be used by street cars. This will necessitate the expensive construction of ramps. However, the same underground level may later on be used by trolley buses as well. The changes recommended here will bring sufficient relief to the congested district to make the first level likely to be adequate for all needs up to 1980. After that time, all public transit will have to be placed underground.

The Parking Problem

The parking problem, acute even now, will increase continuously to the end of the planning interval when there will be three times as many motor vehicles as there are today. Unfortunately the changes in layout of streets and squares decrease parking space. Around the Bubenbergplatz, for example, one hundred fewer parking places will be available.

The counts disclosed that the demand is limited mainly to the Altstadt. Outside the central district there will be almost no shortage. In the Altstadt, two great parking facilities exist already, one a parking garage near the Casinoplatz for 400 cars and the other a parking lot at the Schützenmatte for 200 to 250 cars. Plans are being prepared for a great parking lot on the roof of the central station to accommodate between 420 and 450 cars, while the construction of an underground 300-car garage under the Waisenhausplatz has just begun. These four facilities are very suitably distributed over the central business district. They are all directly connected to the new Tangents' Triangle, so that if one of the facilities is filled to capacity, a car seeking a parking place can reach another lot without crossing the Altstadt.

The new plan provides parking space at the Bahnhofplatz for only forty-five passenger cars and ten taxis, although parking space for between one and two percent of all cars of the city should be available at a major railway terminal. In 1980, there will be at least 40,000 motor vehicles in Bern, of which 25,000 will be passenger cars. Since parking space for 250 to 500 cars will be needed at that time, the projected parking lot on the roof of the station will fulfil an urgent demand. The parking lot may be reached from all parts of the city without crossing the highly congested streets of the central business district. Later the capacity of the parking lot can be doubled by the addition of a second upper level. However, this plan may well be criticized by architects who fear that it would interfere with the beautiful skyline of the old city.

Pedestrian Traffic

At Bubenbergplatz the urgent problem of pedestrian traffic will be relieved by the present recommendations. Pedestrians will pass on both sides of the public transit station, while the station island itself will be used only by passengers.

In front of the railway station building will be four pedestrian crossings; one alongside the hospital on the western side of the Bahnhofplatz, a second starting from the main entrance of the station and going southeasterly, a third one starting from the southeastern corner of the station building, and the last one from the eastern

exit across Bollwerk street. All pedestrian crossings are as short as possible.

If necessary, pedestrian tunnels may be built later on. As a rule, pedestrians do not favor tunnels if other connections exist. A notable exception is in Munich where a very comfortable subway with escalators has been built.

Approval by the City Council

A statement issued by the council of the City of Bern approves the plan as being appropriate and far-sighted. Future traffic regulations will follow the recommendations insofar as possible, although economic considerations may require minor deviation.

With regard to the proposed change from street car to bus and trolley-bus operation, the city council agrees in principle but notes the greater economy of street cars and their high capacity for mass transportation in case of festivals, matches and other such occasions.

The council agrees with the project of the Tangents' Triangle and has already asked civil engineers to prepare detailed projects and calculations for the ramps of the Western Tangent. The proposed changes will, of course, be realized step by step and in due course only.

New York Signal Formula

LAWRENCE LAWTON

Mr. Lawton is Director of Traffic Planning, Department of Traffic, City of New York. In this position he is responsible for traffic signal surveys and design, parking meter program, and special planning studies. He has reviewed many hundreds of investigations resulting from traffic signal requests since his appointment to the department as head of the traffic signal section in 1949. From 1947 to 1949, Mr. Lawton was on the staff of the Bureau of Arterial Route Planning, New York State Department of Public Works. Prior to this he was engaged in expressway design in a consulting engineer's office. Mr. Lawton holds a professional engineer's license from the State of New York. He is chairman of the Institute of Traffic Engineers committee on School Crossing Protection, and is a member of the American Society of Civil Engineers, International Municipal Signal Association, and the Municipal Engineers Society of New York.

TRAFFIC agencies get many requests for signals. The volume of mail received makes it obvious that a good many of our citizens are convinced that a signal is just what the doctor ordered.

Superficially, it would seem that a signal is the answer to the entire accident problem at intersections. When the light is green for the avenue, both pedestrians and cross traffic wait. When the avenue red goes on, the cross street green is illuminated and both pedestrians and vehicles can cross the main street. What could be simpler? How can an accident occur? The light is either red or it is green. Why isn't a signal placed at each intersection in an urban area?

Something must be wrong, however, with this idea that the red and green lights spell safety. The accident records do not bear out this line of reasoning. After all, the overwhelming majority of all requests for traffic signals stems from the supposition that signals are necessary for pedestrians to cross the street in safety. The plain fact is this: Eighty percent of the pedestrians (and this includes children) who are killed and injured at intersections in New York City are struck *at signalized intersections!*

Signals are wonderful gadgets. The driver and the pedestrian

both look at the traffic lights, but they sometimes don't look at each other. Most people trust the other fellow's proper observance of the signal. Unfortunately this observance is not always proper—especially when the signal was not warranted in the first place. Drivers are tempted to cheat more at signals when relatively few pedestrians and vehicles are crossing the main street.

"Well, this sounds all right," says the average citizen, "but I still can't see how a traffic signal can cause accidents." Accidents happen to people, so let us examine a situation which can cause an accident. A motorist driving down the main street sees the green light is still on at the cross street just a few hundred feet ahead. We would be right in supposing that the average driver would mentally alert himself to stop. But need we consider the average motorist or, for that matter, the average pedestrian?

Accidents Occur in Unusual Situations

During any one hour at an intersection being considered for signals, several hundreds of vehicles and pedestrians enter the intersection. This goes on hour after hour, throughout every day. Several millions of opportunities for an accident occur during the course of a year. Yet even the worst of unsignalized intersections will have fewer than ten accidents in any one year. It should be obvious then that accidents do not result from the actions of average people in average situations. From the small number of accidents which occur out of millions of opportunities, it is logical to conclude that most accidents occur to unusual people in unusual situations.

Let us get back to our unusual driver who is going to make the light. While this is happening, a pedestrian has been patiently waiting for her green light. She has actually been waiting only twenty-five seconds, but she is convinced that half an hour has gone by. Still she is determined not to cross against the signal.

The yellow light goes on for the main street. Instead of applying the brakes, our driver pushes the gas pedal to the floor. Why not, especially since he could never see why they put this particular light up in the first place. Two seconds after the signal has turned red, his car enters the intersection. He took a good look—there were no cops around. Meanwhile, the pedestrian has started to cross the

street, having the green light. Both driver and pedestrian have made the fatal mistake of watching the light instead of watching each other. The result can well be imagined.

Then why, if signals can cause accidents, are any signals installed? Well, if warranted, signals do two important functions. Vehicular and pedestrian delay can be decreased and some types of accidents will be reduced. If, for example, the intersection of Fifth Avenue and 42nd street did not have signals, chaos would result. Vehicles would jam the intersection and traffic would back up for miles. The pedestrian would be on his own in trying to fight his way through hopeless snarl. Time-consuming congestion would occur and accidents to both drivers and pedestrians would be at a phenominal rate.

Obviously if traffic is light and moves freely, placing a traffic signal in operation will cause half the traffic to stop. And if the pedestrian has only to wait ten or fifteen seconds for a gap in traffic, a signal will cause him to wait much longer.

Experienced traffic engineers throughout the country find that traffic signals usually have the following effect on accidents:

When there have been a large number of accidents a signal usually reduces the frequency. A moderate accident rate is not appreciably changed with the installation of a signal. But where few or no accidents have occurred, signal operation has usually increased the accident frequency.

There is a simple question to be asked about an intersection under consideration for traffic lights. Will installing a signal improve traffic conditions, or will results be worse? While the question is simple, the answer is quite complex. By examining the individual components of this answer we can work out an organized, logical way of making a traffic signal determination.

Adapting the Formula

A series of warrants for signals have been set up in the "Manual on Uniform Traffic Control Devices."[1] These warrants are the result of the pooled judgment of traffic engineers with long experience in

[1] Published by the Bureau of Public Roads, August, 1948.

this problem. It is generally agreed in the profession that these warrants are just and reasonable.

Adapting these fixed formulations to the many different conditions found on the street, should be worked out within the confines of each of the warrants cited, plus a few herein introduced. Also to be determined is a combination of warrants.

Five warrants are given in the Uniform Manual. These are: minimum vehicular volume, interruption of continuous traffic, minimum pedestrian volume, coordinated movement, and accident hazard. A signal is supposedly warranted, if any one of the individual warrants is met, or if two or more of the warrants exceed eighty percent.

As an example, an intersection which has top rating in the through-traffic warrant makes a poor showing in the other warrants. How does this stack up against a second intersection in which seven-tenths of each of the warrants is satisfied? If there is a shortage of funds, which of these two should be signalized first?

The obvious way to handle this problem is to give a rating under each of the individual warrants and then make the total rating of each intersection the sum of the individual ratings. In this way priorities of signal installation can be set up.

1. *Volume Rating*

The Uniform Manual gives the following vehicular warrant. "Total vehicular volume entering the intersection from all approaches must average 750 vehicles per hour for the eight highest hours . . . of which 175 vehicles per hour must enter from the side street." It is the judgment of experienced engineers that when this much traffic enters an intersection, congestion is inevitable and traffic signal operation is necessary. Subtracting 175 from 750 gives a condition where the main street volume (Vm) is 575 and the cross street volume (Vc) is 175 vehicles per hour.

What should be done when Vm is 350 and Vc is 300? What is the relative exposure to accident and delay in this case? A true, scientific answer would involve the theory of the interaction between two intersecting traffic streams as described by Mr. Morton S. Raff:[2]

2 "A Volume Warrant for Urban Stop Signs," by Morton S. Raff, Eno Foundation, Saugatuck, Conn., 1950.

"This, then, is the big unsolved problem: how to deal mathematically with the situation which arises when a pile fails to clear during a single anti-block . . . This is mathematical discontinuity, for an infinitesimal change in one variable, the length of the anti-block, causes a finite change in the variables which are dependent on it.

"The mathematical complexities arising out of this discontinuity are enormous. When they are surmounted it will become possible to make a highly important contribution to the theory of traffic behavior."

To evaluate the exposure and delay effect on vehicles it will be assumed that the difficulty is proportional to the product of the two volumes. In other words, forty cars crossing one hundred cars is four times as complicated as ten cars crossing one hundred cars. Let us then multiply Vm times Vc in our warrant condition.

$$(Vm)\ (Vc) \text{ equals } (575)\ (175) \text{ equals } 100{,}000$$

Since this is our standard, let us give it a rating of 100. Then we can get any rating by multiplying Vm times Vc and dividing by 1000. In formula form the volume rating is:

$$V \text{ equals } \frac{(Vm)\ (Vc)}{1000}$$

Using the previous example where Vm is 350 and Vc is 300

$$V \text{ equals } \frac{(350)\ (300)}{1000} \text{ equals } 105$$

The formula has been found to work quite well when the cross street volume (Vc) is at least a quarter of the main street volume (Vm). However, when Vc was less than 25 percent of Vm, the formula rating did not agree with the judgment of experienced traffic engineers.

This condition usually occurred when the main street had four or more moving lanes. For a given volume of traffic on the main street the lane density is half on a four-lane street as compared to a two-lane street. Also on wide city streets, traffic moves essentially in platoon fashion because of interruptions due to signals, etc. Finally it was felt that when the minor street traffic was comparatively small,

the main street traffic was being unduly penalized to provide comfortable traffic signal entrance for the minor traffic stream.

To handle this problem the use of an empirical reduction factor has been adopted. The values of K were first determined by field observation in Detroit and have been found to give good results in New York. In the New York formula the volume rating is divided by K since it is more logical to think of K as a reduction factor rather than as an abstract ratio.

When: $\frac{\text{Vm}}{\text{Vc}}$ less than or equal to 4, K equals 1.0

$\frac{\text{Vm}}{\text{Vc}}$ between 4 and 8, K equals 1.5

$\frac{\text{Vm}}{\text{Vc}}$ more than or equal to 8, K equals 2.0

As expressed above, the value of K jumps abruptly when Vm divided by Vc is in the neighborhood of either four or eight. To avoid this condition a straight line increase in K, between the stated ratio values of four and eight, has been adopted in the following table.

Vm/Vc	4 or less	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8 or more
K	1.00	1.13	1.25	1.38	1.50	1.63	1.75	1.88	2.00

The Volume Rating is then:

$$\text{V equals } \frac{(\text{Vm})\quad(\text{Vc})}{(\text{K})\quad(1000)}$$

Vm is the vehicular volume entering the intersection from the main street and Vc the vehicular volume entering from the cross street. Both Vm and Vc are the average volumes for the eight highest hours.

2. *Pedestrian Rating*

The Uniform Manual gives the following criteria for a pedestrian warrant in an urban area:

1. "Pedestrian volume crossing the major street must average at least 250 persons per hour for any eight hours of an average day." (Pm).

2. "Vehicular traffic entering from the major street must average at least 600 vehicles per hour for the same eight hours." (Vm).

There is still another factor to be considered. As the width of the street increases, all other things being equal, the more difficult it becomes for the pedestrian to cross. A 40–foot street will be considered as the norm. The difficulty is then considered to vary in the direct proportion that the main street width is to forty feet.

From the Uniform Manual:

$$P \text{ equals } \frac{Vm}{600} \times \frac{Pm}{250}$$

considering width of street

$$P \text{ equals } \frac{Vm}{600} \times \frac{Pm}{250} \times \frac{Wm}{40}$$

Rating is therefore the above times 100

$$P \text{ equals } \frac{(Vm)\ (Pm)\ (Wm)}{(600)\ (250)\ \ (40)} \times 100$$

$$P \text{ equals } \frac{(Vm)\ (Pm)\ (Wm)}{60{,}000}$$

It is much easier for a pedestrian to cross a street with a center island. In effect the pedestrian is crossing two separate streets. Therefore, when there is a mall in the street, Wm will be half the width of the street and Vm will be half of the two-way volume.

3. *Accident Rating*

The Uniform Manual cites the following accident hazard warrants:

1. Adequate trial of less restrictive remedies . . .

2. Five or more reported accidents of types susceptible of correction by traffic signal control within a twelve-month period . . .

A traffic signal, if observed by drivers and pedestrians, can be expected to reduce the following types of accidents:

1. Right angle collisions.

2. Conflicts between straight-moving vehicles and crossing pedestrians.

A signal will not reduce the following types of accidents:

1. Rear end collisions, which often increase after signalization.

2. Collisions between vehicles proceeding in the same or opposite directions. At a traffic signal, these movements usually take place on the same green light. A good example is a left turn accident.

3. Accidents involving pedestrians and turning vehicles.

According to the standard set by the Uniform Manual, an average of five accidents per year, *of a type preventable by a traffic signal* (a), will be considered to be the norm:

Rating is then:

$$A \text{ equals } (20)(a)$$

4. *Through-Street Rating*

In the section on Volume Rating it was noted that adjacent traffic signals on the main street create platoons of traffic. The platoon movement tends to create definite gaps in traffic, making it easier for both vehicles and pedestrians to cross. When traffic signals are spaced 1200 feet or less, the platoon effect is clearly defined. As the distance between signals becomes larger, the vehicles become more dispersed. Finally, when the signal spacing is greater than 4000 feet, vehicles do not in any sense travel in compact groups and assume the random spacing found on the open highway.

The Uniform Manual uses 750 vehicles average during the eight highest hours as the norm. Let D equal Distance between adjacent traffic signals on main street

Then:

$$T \text{ equals } \frac{D - 1200}{4000 - 1200} \times \frac{Vm}{(750)} \times 100 \text{ equals } \frac{Vm(D-1200)}{21{,}000}$$

Note:

1. If D is less than 1200 feet, rating equals zero.
2. If D is more than 4000 feet, use D–4000.
3. Maximum rating is 100.

5. *Progression Rating*

Progressive signal operation is almost entirely a function of the signal spacing. Take as an example a system in which the signals are spaced 900 feet apart. As long as this spacing is maintained progression will be perfect. The signals are then said to be half a cycle apart and 900 feet is the half cycle distance. If a signal were to be placed in the worst position, halfway between two of these signals, it would be at the quarter cycle point. In this case at least half of the vehicles moving in the progressive band would be stopped. To measure this effect, the progression rating (PR) has been established.

(a) at ½ cycle points equals 0
(b) at ⅛ cycle points equals (–) 25
(c) at ¼ cycle points equals (–) 50

6. *One Way Streets*

If an intersecting street is one way, it is much easier for both pedestrians and vehicles to cross. There is only one direction of traffic to watch instead of two. And if there is a nearby signal on the main street, in the direction that traffic is coming from, well defined crossing gaps are established.

(a) Both streets one-way, no signals equals (–) 20
(b) Main street one-way, signal within 500 feet equals (–) 50
(c) Main street one-way, signal within 1000 feet equals (–) 35
(d) Main street one-way, signal within 1500 feet equals (–) 20

7. *Additional Warrants*

School Crossings:[3]

a) Consult school crossing plan and check if crossing is on a "schoolway." If not a legitimate school crossing, request for school

[3] Adopted from "Traffic Controls in the Vicinity of School Zones," 1953 Proceedings of the Institute of Traffic Engineers. See Table II.

signal is automatically denied and routine signal investigation is made.

(b) If there is an adjacent signalized school crossing, an additional school signal will be granted *ONLY IF there are at least 600 feet of additional walking distance to the nearest school gate.*

(c) If (a) and (b) are satisfied, use one safe gap per minute as the critical value (see table) for a school crossing signal. The highest two-way hourly volume during school crossing time should be used. If the intersection is a school crossing, but does not qualify under the gap warrant, treat as an ordinary intersection and add twenty points.

Churches:

Add five points.

Offset Intersections:

Cross traffic flow is never smooth at an offset intersection. Signal control almost always makes this undesirable condition even worse. Depending on the severity of the offset, a maximum of 50 points will be deducted.

O equals (–) 10 to (–) 50

Hill:

A signal located on a steep grade or at the bottom of a hill gives a false sense of security to crossing vehicles and pedestrians during snowy or icy conditions in the winter time. Under this condition a green signal can well be an invitation to danger.

H equals (–) 50

"T" Intersection

At a "T" intersection all of the cross traffic on the stem of the "T" must turn. These vehicles, therefore, will cross the path of pedestrians crossing the main street on the same green light. Also note that the vehicular rating uses only the volume of traffic *entering* the intersection from the stem of the "T" for Vc, not the two-way volume on the stem.

Use (–) 50 for the rating.

Conclusion

The signal rating used in New York is adopted from the so-called Detroit formula which originated in the traffic engineering bureau of that city (Table I.) We have made some modifications, minor in nature, as a result of making many hundreds of signal investigations. The final rating cannot be viewed as having a mathematical certainty because each of the individual components are empirical in nature and their comparative importance is at best a well-educated guess. However, the rating to a large degree does help separate the wheat from the chaff. When the total rating is over 300 a signal is usually warranted and when the rating is under 200 the contrary is true. Where the total is between 200 to 300, a more thorough study by an experienced traffic engineer is called for.

Table I

Signal Warrant Calculations (N.Y. System)

CALCULATION

WARRANT **RATING**

VOLUME (based on average hour of the 8 highest hours)

Vm = Vehicles entering intersection from main street_____
Vc = Vehicles entering intersection from cross street_____

Vm/Vc	4 or less	4.5	5.0	5.5	6.0	6.5	7.0	6.5	8 or more
K	1.00	1.13	1.25	1.38	1.50	1.63	1.75	1.88	2.00

$$V = \frac{(Vm)\ (Vc)}{(K)\ (1000)} = \frac{(\ )\ (\ )}{(\ )\ (\ )} =$$

PEDESTRIAN (use average of 8 highest hours)

Pm = Pedestrians crossing main street at crosswalk _____
Wm = Width, curb to curb, of main street _____
If center island, use ½ Vm, _____ and ½ Wm, _____

$$P = \frac{(Vm)\ (Pm)\ (Wm)}{60{,}000} = \frac{(\ )\ (\ )\ (\ )}{60{,}000} =$$

ACCIDENT

a = Accidents preventable by a traffic signal _____

$$A = (20)\ (a) = 20\ (\ ) =$$

THRU STREET

D = Distance between adjacent signals on main street _____
a) = If D is less than 1200 feet, rating = 0, check ( )
b) = If D is more than 4000 feet, use D = 4000, check
c) = Maximum rating is 100, check ( )

$$T = \frac{(Vm)\ (D-1200)}{(21{,}000)} = \frac{(\ )\ (\ -1200)}{(21{,}000)} =$$

PROGRESSION

New signal at ½ cycle point = 0, check ( )
New signal at ⅛ cycle point = (–) 25, check ( )
New signal at ¼ cycle point = (–) 50, check ( )

=

ONE-WAY STREETS

a) Both streets one way, no signals = (–) 20, check ( )
b) Main street one way, signal within 500′ = (–) 50, check ( )
c) Main street one way, signal within 1000′ = (–) 35, check ( )

=

ADDITIONAL WARRANTS

SCHOOL a) less than ____ gap/min., school sig. warranted ( )
b) if more than 1 gap/min., +20, ( ) check
CHURCH +5 ( ) check
HILL (–) 50 ( ) check
OFFSET INTERSECTION (–) 10 to (–) 50 ( ) check
"T" INTERSECTION (–) 50 ( ) check

=

TOTAL RATING

Table II

Safe Gap Table—School Crossings

Values given below are the two-way volumes of traffic which will permit one safe gap in traffic in one minute. Use highest volumes obtained from automatic machine count during school crossing hours.

STREET WIDTH (FEET)		TRAFFIC VOLUME		
Curb Parking Along Major St.	Moving Vehicles in Curb Lane	Single Child or Small Group	Medium Group 10′ Platoon	Large Group 20′ Platoon
24	—	1140	675	480
26	16	1010	620	465
28	18	910	570	450
30	20	815	520	435
32	22	740	500	420
34	24	675	480	405
36	26	620	465	390
38	28	570	450	375
40	30	520	435	360
42	32	500	420	350
44	34	480	405	340
46	36	465	390	330
48	38	450	375	320
50	40	435	360	310
52	42	420	350	300
54	44	405	340	290
56	46	390	330	280
58	48	375	320	270
60	50	360	310	265
65	55	335	285	245
70	60	310	265	230
75	65	285	245	215
80	70	265	230	200

Retail Structure of Urban Economy

EUGENE J. KELLEY

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THE spatial structure of American retailing is being changed by three forces familiar to those concerned with traffic and highway matters. These forces are the suburban population movement, the increasing dependence of the consumer on the private automobile for shopping, and the growing number of high speed roads enabling consumers to travel miles from home even for convenience goods purchases.

The response to these forces has produced substantial changes in consumer behavior and merchandising practices. It has been estimated that 50 percent of the automobile driving public will travel thirty minutes to reach a shopping center when assured of satisfactory merchandise assortments and parking conditions. But so slowly does our thinking adapt to change and so slowly do adjustments develop, that the full impact of these forces on the metropolitan economy may not yet be fully appreciated.

The average American city is still twenty or twenty-five years behind adjustment to the automobile. So when it is remembered that the three forces mentioned have gained momentum only since the end of World War II, it is understandable that some have not grasped fully the extent of the marketing revolution currently underway. As recently as 1950, only a handful of business men and economists visualized the change in spending-patterns that would be brought about by the suburban population movement and other

forces. A statistical overview of some retailing results of this "painless" revolution was given by McMillan. These numbers in parentheses (1) refer to notes at end of article.

This article presents a conceptual scheme for analyzing the retail structure of the metropolitan economy and offers some guides to the placement of regional shopping centers in the structure. Regional centers are one of the most spectacular recent evidences of the dynamism of the retail structure and of the American economy. The use of space as a business resource is commented upon here prior to discussion of the retail structure and placement of controlled shopping centers in the structure.

Spatial Positioning in Marketing

Sellers of goods have generally been preoccupied with the task of creating demand for their products. Certainly, the greatest amount of marketing managerial time, energy, and imagination has been focused on the product and its promotion.[1] The spatial and temporal conditions influencing the sales of the product typically have received less study than creating demand. Yet sellers are concerned with the creation of time and place as well as possession utilities. Creation of space utility is an area in which traffic engineers, architects, and planners have much to contribute to business. All of these specialists are interested in the intelligent use of space in the metropolitan economy.

A seller has four decisions to make about the ideal spatial relations or positioning of his product in the market.[2]

1. He must first select the area or areas in which he will offer his goods. These areas are his markets.

2. He must make a choice among the types of distributive agencies selling space in the market. Will space be preferred in drug or hardware stores, mail order catalogs or department stores? This is selecting the channel of distribution.

[1] The art of marketing is the manipulation of temporal, spatial, and possessory forces to achieve an objective in management. As a discipline, marketing is the study of the temporal, spatial, and possessory forces influencing economic transactions, and of the interacting efforts and responses of traders (buyers and sellers) in the market.

[2] The writer is indebted to Dr. Lincoln Clark for this concept and for other guidance given during the preparation of a Ph.D. dissertation at the Graduate School of Business Administration of New York University.

Institutions to supply the chosen retail outlets must be selected. Will a service wholesaler offering full decentralized spatial services be used or will a limited function middleman such as a manufacturer's agent represent the better channel?

3. He must select within competing retail and wholesale institutions of the same type. Will a policy of exclusive, selective, or intensive distribution be followed? Will Chain A or Chain B or both be used? Are urban, suburban, or rural positions preferred?

4. Finally, there are questions of the desired internal positioning of the goods within the outlets. This involves questions of layout and display.

This article is concerned with an aspect of the third level of spatial decision. Specifically, the nature of controlled shopping centers is examined and some impacts of these centers on the retail structure are suggested.

Impacts of Locations on Retailing

Business men are generally quite aware of the importance of the right location to market oriented plants and stores. Some study has been given to the effect of different locations on the volume of goods sold. But many of the other relationships between locations and the creation of possession utilities have not been explored.

Location is important not only as it affects the volume of goods sold, but as it influences other variables of marketing transactions. For instance, what are the effects of different locations on: the quality and type of goods offered and sold, the degree of sales service required, and the amount of promotion and information needed to complete marketing transactions? What effects do different locations have on the time people buy, the frequency with which they purchase, the prices they pay, and the cost of sales? What are the impacts of a new location on business done at other locations?

In terms of regional centers, how will the establishment of regional centers affect marketing transactions in other elements of the metropolitan retail structure? These questions concerning the effect of position in space on consumer behavior seem relevant whether one is concerned with increasing the profits of a particular enterprise or advancing science in business.

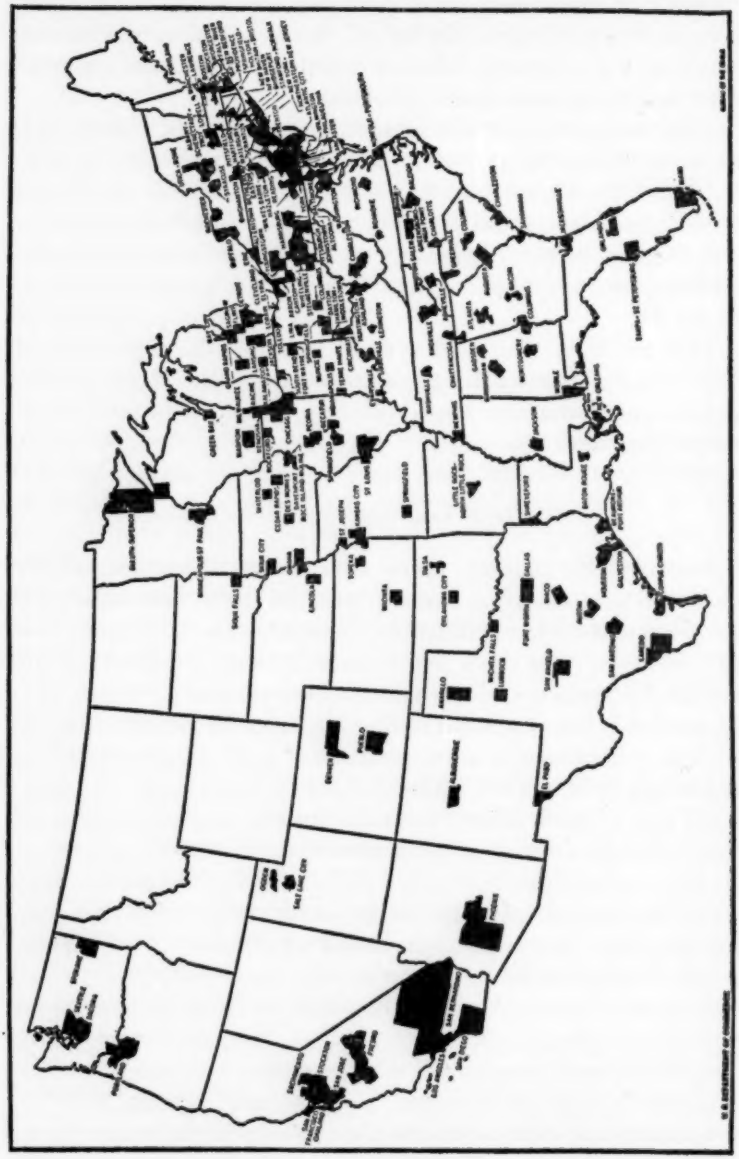

FIGURE 1. Map of Standard Metropolitan Areas 1950

Merchants have recognized some differences between customers shopping downtown and in regional center stores. The two groups of customers are from different sections of the metropolitan area, from different income groups, have different tastes and attitudes, and even may be of different sizes. Specifically, shopping center customers buy more sports clothing, casual wear and children's clothing than do patrons of downtown stores.

It is probable that retailers experimenting with suburban locations will continue to find that merchandising problems vary between locations, even though basically the same lines may be carried. But what will the nature and extent of the difference be? How will the home-owning child-raising, casual living, do-it-yourself families of suburbia differ from their central city cousins shopping exclusively in downtown stores?

These questions are important since suburbanites represent the most important single market in the country. Forty million people comprise the suburban market today, but this figure alone does not tell the whole story. The suburban market contains more than its share of middle income consumers in the 25–45 year-old age bracket. *Fortune* reported that the average family unit income of the suburban population in 1953 was $6,500 or 70 percent higher than the rest of the nation. (2)

As a starting point for analyzing the above questions the elements comprising the retail structure are identified along with certain characteristics which may aid in formulating hypotheses about the questions raised. The shift of retail sales from the cores of the larger cities to other elements in the structure makes it more important than ever to consider as a market unit the entire metropolitan area rather than just the central city or any political sub-division.

In main outline the retail structure of the 168 standard metropolitan areas follows the pattern suggested in this article. In 1950 the areas had a population of 84,500,680—more than half the people enumerated in the continental United States.

FIGURE 1. The standard metropolitan areas occupy only 7 percent of the country's land area, but account for two-thirds of the retail volume and about nine-tenths of the wholesale volume of the nation. Map source: *United States Census of Population, 1950, Number of Inhabitants,* Washington, Bureau of the Census, 1952, Vol. I, p. xxxiv.

There is a wide variety in the distribution of the approximately 1,748,000 retail outlets in this country. Yet classification into groups for locational analysis is possible. Duncan and Phillips (3) maintain that in their main outlines the retail structure of cities and their surrounding areas is generally similar. These authors identify a central shopping district, secondary or outlying shopping centers, neighborhood business streets, and scattered individual stores or small clusters of stores.

Elements of the Retail Structure

Brown and Davidson (4) offer a five-fold classification of store locations found in most metropolitan areas: central shopping district secondary shopping districts, string street locations, neighborhood clusters, and isolated locations. Weimer and Hoyt classify the retail structure into business districts, outlying business centers, and isolated outlets and clusters. (5) Other analyses in the literature of marketing and real estate follow a similar pattern.

A new classification of elements is suggested here, integrating controlled shopping centers into the retail structure of metropolitan areas. Some of the key relationships between elements are summarized in Table I.

The Retail Structure

1. Central business district
   - A. Inner core
   - B. Inner belt
   - C. Outer belt

2. Main business thoroughfares (string streets)

3. Secondary commercial sub-districts (unplanned)
   - A. Neighborhood
   - B. Community or district
   - C. Suburban or outer

3a. Controlled secondary commercial sub-centers
   - A′. Neighborhood
   - B′. Community or district
   - C′. Suburban or outer

4. Neighborhood business streets

5. Small store clusters and scattered individual stores

6. Controlled regional shopping centers.

1. *Central business district:* A Commerce Department study in 1935 used terminology that can be helpful in considering the structure of central business districts. The terms are "inner core," "inner belt," and "outer belt." Figure 2.

The inner core of the central business district is typically the point at which all intra-city traffic converges, the center of shopping and specialty goods activity and the home of the large department stores. (6) In the inner belt are found communication agencies, banks, law offices, the administrative offices of political, recreational, religious, and other services. The inner core and belt comprise the heart of the retail structure and also of these other activities as well. Through these offices the "manifold activities of the community are directed and integrated. The special function of the principal center is that of dominance or control . . ." (7)

The first two elements of the central business district are typically the home of the largest stores, both in floor space and volume. Some convenience-goods retailers are located in the central business district, but the shopping and specialty goods stores are the magnets which draw customers from the entire metropolitan area to shop downtown. The inner core of the central business district has the highest concentration of pedestrian traffic in its relatively small area. Because of these factors land values are highest here so that only high volume retailers can ordinarily compete for premium locations in this area.

In the inner belt immediately surrounding the core, land values are lower and pedestrian traffic much less concentrated than in the inner core. The separate but related functions of government, finance, professional services, cultural, entertainment, and wholesale activities are found here.

The third element of the central district is the outer belt. This generally includes less desirable commercial structures and dwellings, and some residential areas that have run down and are on the verge of becoming slums.

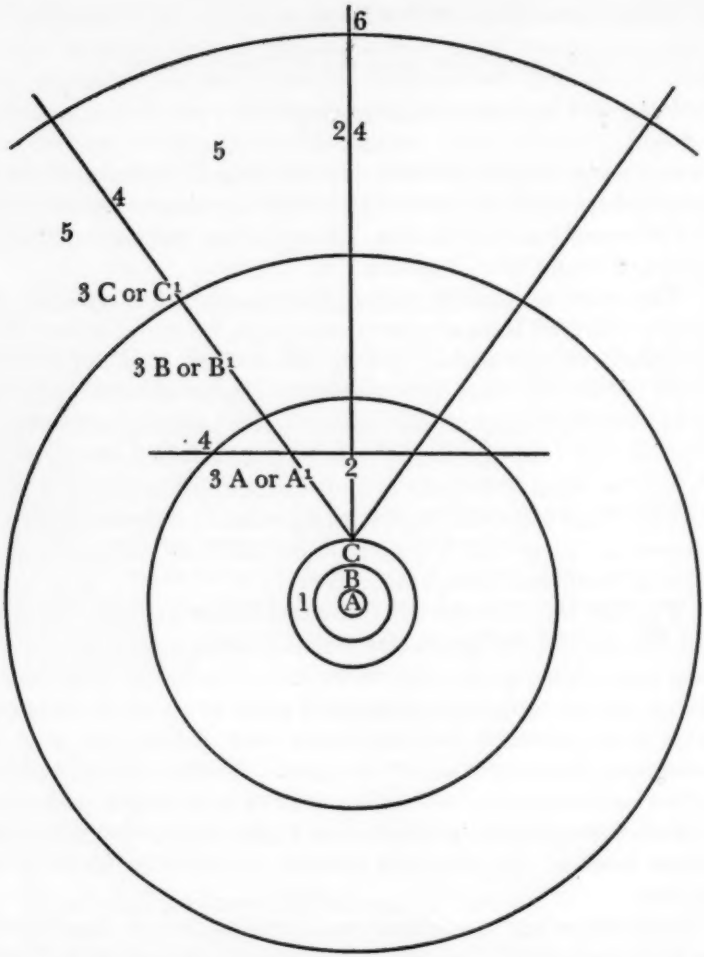

FIGURE 2. Schematic Presentation of the Retail Structure of Metropolitan Areas.

2. *Main business thoroughfares:* Leading out of the central business district are streets lined with all kinds of retail outlets and services. These thoroughfares are described as "string streets." Such streets are heavily traveled by automotive and pedestrian traffic. Retailers on these streets do not depend on residents of their immediate

area for patronage but are favored mostly by people using the street as a thoroughfare.

Some of these streets developed when streetcar routes from the central business district were laid out on fixed rails, and various types of commercial enterprises lined up along both sides of the streetcar system. Automobile dealers, furniture stores, and nearly every other type of consumer goods merchandiser can be found along the main business thoroughfares of most American cities.

3. *Secondary commercial sub-districts:* Commercial sub-districts develop as the population of the central city increases. It then becomes more convenient for people in neighborhoods away from the downtown area to shop closer to home more often, instead of journeying downtown to the central business district. Merchandise sold in secondary commercial sub-districts is similar to that sold downtown. However, the breadth and depth of lines carried is more limited, the stores smaller, and customers are drawn from a smaller area. A larger proportion of convenience-goods stores is located in these areas than in the downtown districts.

Typically secondary commercial sub-districts are located on heavily trafficked routes between residential areas and the central city. On the basis of parking facilities, two types of secondary shopping areas can be distinguished. The first is situated on or off the main business thoroughfares. In these sub-districts only curb parking is available for the automotive customer. Newer and modernized secondary shopping areas attempt to provide off-street parking for customers. All properly controlled neighborhood, community, or district centers offer this service. The great majority of commercial sub-centers are uncontrolled.

3a. *Controlled secondary sub-centers:* Structurally each type of controlled center is placed in relation to the trading area it is designed to serve. Controlled neighborhood shopping centers are built near the areas occupied by neighborhood business districts. Community or district centers of the controlled variety are located in appropriate secondary shopping areas. Controlled suburban shopping centers are situated farther out near suburban cities. Controlled regional shopping centers are planned either in a suburban location or at a point beyond the typically suburban. In this matrix the next signficant retail element is the neighborhood business street.

4. *Neighborhood business streets and areas:* Neighborhood business streets contain convenience-goods stores with primarily a neighborhood appeal. These streets typically include a small cluster of several kinds of retail establishments on heavily traveled streets or at an intersection of two or more main thoroughfares. The principal trade comes from neighborhood residents.

5. *Small clusters and scattered individual stores:* Clusters and scattered individual stores also deal basically in convenience-goods. The clusters are made up of two or more complementary, rather than competitive convenience-goods stores. Individual stores and small clusters are scattered throughout the residential areas of cities and towns surrounding the central city wherever population density invites more convenient shopping facilities than provided by neighborhood centers.

6. *Controlled regional centers:* Controlled regional shopping centers have nearly all been built in suburban areas. But the centers are intended not only to attract patrons from immediately surrounding areas, but from the entire region or quadrant of the metropolitan area in which they are located. A region may include all customers within a given driving-time distance, usually thirty or forty minutes from the site. Regional centers are situated far enough out in suburbia for the land to be relatively inexpensive. Tracts can be used without the expense of demolishing too many existing structures.

A basic reason for preferring the suburban location is the large amount of non-selling space needed for a regional center. The center's layout is designed to provide ample parking facilities even for peak periods. Parking space may occupy from three to nine times as much area as the floor space devoted to the sale of merchandise. (8)

Characteristics of Controlled Centers

Controlled shopping centers are considered to have the following characteristics:

1. The land on which the center is situated is owned by a single agency. Typically the buildings are also owned by the developer, but concessions in this respect might be made to department store tenants. The factor of single ownership makes possible an unusual

measure of control of architectural, parking, service, and other features of the center by the developers.

2. An assortment of different types of retail outlets offering a balanced representation of goods and services is featured. The stores are on one integrated site designed for one-stop shopping at the level of trade area being serviced, i.e., neighborhood, community, suburban area, or region.

3. Planning is done in advance of construction. The completed shopping center is designed as an integrated, harmonious unit, as an efficient merchandising machine. The controlled center is developed according to specifications by architects, market analysts, and other types of consulting specialists.

On the basis of the trading area served, four types of controlled centers have been distinguished. These are the neighborhood, community or district, suburban or outlying central city, and regional centers.

a. A neighborhood shopping center is one comprising seven to fifteen retail outlets selling primarily convenience-goods. A supermarket is the core of this type of center. Neighborhood centers serve a minimum of 750 families or about 3,000 people. Larger neighborhood centers may serve as many as 15,000 people. Store groups of six or less are ordinarily better described as small store clusters than as shopping centers.

b. Community or district centers draw greater numbers of customers from wider areas than do neighborhood centers. The trading area usually includes several neighborhoods within one to three miles of the site. A population of between 15,000 and 30,000 is typical of the community center's trading area. The community center includes, in addition to the service stores found in neighborhood centers, a complete range of convenience-goods outlets, shopping and specialty goods stores emphasizing apparel and home furnishings in the middle price ranges, professional offices, and usually a branch bank.

It is characterized by a greater depth of merchandise than the neighborhood center. Automotive traffic is more important than in the neighborhood center and off-street parking facilities generally have to be provided. From sixteen to thirty-five stores are found in the usual community center.

Table I

The Retail Structure of the Metropolitan Economy

Retail Element	*General Character*	*Source of Customers*	*Store Types*	*Parking*	*Traffic*	*Goods Sold*
1. Central Business District A. Inner core B. Inner belt C. Outer belt	Inner core and belt solidly commercial. The business and recreational heart of metropolitan economy. Residents fill in back streets. Typically, residential areas are blighted.	Come from all parts of city and tributary area. Sites are most accessible to most consumers. Intra-city transportation converges in this element.	Largest in floor space and volume. Multi-story department store is symbolic. Home of specialty shops. Outer belt activity less intense. These stores do smaller volume per unit.	Totally inadequate in inner core and belt. Trend to provide public lots and commercial parking lots to supplement limited curb parking in inner belt and outer belt.	Extremely heavy. Congested during peak periods.	Shopping and specialty goods emphasis. Area is center of apparel, home furnishings, other department store lines. Service and other commercial activities found in belts.
2. Main Business Thoroughfares (String streets)	Mixed zone of retail and light industrial enterprises and working class homes. Featured by long series of miscellaneous stores.	Basically trade is transient, consisting of commuters, suburbanites, and inter-city automotive traffic. Some patronage from neighborhood residents.	Concentration of larger food stores, automobile dealers, and supply houses, service and convenience-goods stores.	Usually dependent on curb parking. Inadequate during most periods.	Streets are main traffic arteries. Usually heavy, but particularly so during commuting peaks.	Essentially business streets. Stores are widely spaced over length of artery.
3. Secondary Commercial Subdistricts (unplanned) A. Neighborhood B. Community or district C. Suburban or outer	More residential than first two elements. Owner-occupied residences increase with distance from central business district. The sub-districts tend to appear. island-like, along string streets.	Come basically from A, B, or C trade areas. The districts developed as city grew at focal points of intra-city transportation. Dependent on traffic brought by public carriers.	Unplanned competition featuring convenience and shopping goods. B and C tend to be miniatures of central business districts.	Mostly curb, plus some off-street parking provided by individual merchants.	Since stores are typically clustered at key intersections and transfer points of public carriers, the traffic is heavy.	Convenience-goods featured in A. Increasing shopping goods emphasis in B and C.

THE RETAIL STRUCTURE OF THE METROPOLITAN ECONOMY *(continued)*

Retail Element	*General Character*	*Source of Customers*	*Store Types*	*Parking*	*Traffic*	*Goods Sold*
3a. Controlled Secondary Commercial Subcenters A′. Neighborhood B′. Community or district C′. Suburban or outer	Waste area and marginal stores at a minimum. Found near more prosperous residental areas. Unified architecturally. Most built after World War II. New, fresh appearance compared to 3.	Greater dependence on automotive traffic. Parking provided so customers are drawn from greater distances than in case of unplanned centers. Generally found in suburban district.	Balanced collection of supplementary stores possessing aesthetic appeal. Centers stress convenience and service, not price appeals.	Provided on a cooperative basis within the center. Parking and other facilities related in size to surrounding trade area.	Parking for private automobiles key consideration. Even so, automotive traffic heavy.	Attempt made to present an integrated retail organism to customers coming from A′, B′, or C′ distances. A′ stresses convenience-goods. B′ and C′ feature shopping and specialty merchandise.
4. Neighborhood Business Streets	Residential with commercial use distinctly secondary.	Neighborhood is primary source. Most customers come from within walking or 5 minutes driving distance.	Usually rows of convenience-goods outlets found in center of neighborhood community.	Mostly curb. Due to convenience-goods nature of most items sold, parking turnover is rapid.	Heavy during peak hours. Otherwise not a handicap to trade.	Emphasis on food and drugs. Grocery store-drugs combination frequent. Service stores common.
5. Small Clusters and Scattered Individual Stores	More thinly populated residential areas. Neighborhoods tend to be middle class.	Come from homes not within easy reach of larger elements in structure. Many walk to stores.	Smallest outlets in structure. Many are marginal. This classification dominated by food and general.	Curb and small lot parking usually adequate.	Usually not a problem. The lack of traffic congestion, plus the availability of parking, represents an appeal of this element to customers beyond neighborhood range.	Usually supplementary and not directly competitive.
6. Controlled Regional Shopping Centers	Overall unity obvious at a glance. Landscaped frequently. Off-street parking. Harmonious effect is objective. May be equipped to serve as area's civic and cultural center.	Drawn from families within 30-minute driving range. Customers typically come from a number of suburban communities. Pull varies with effectiveness of central business district retailers and competing centers.	Attempt made to dpulicate shopping facilities of central business district with minimum of overlapping. "One-Stop Shopping in the Suburbs."	Usually best facilities in metropolitan area. Adequate for all but occasional peak periods.	Problem usually under control as a result of coordinated planning.	One or two department store branches and satellite stores offer widest range of merchandise and services outside central business district.

c. Suburban or outlying central city centers normally serve a population of 30,000 to 100,000 people and are commonly built around a department store branch or two and several large supermarkets. Generally, except for unusual specialty items, an assortment of merchandise adequate to serve all needs of the trading area is offered. The centers serve a large suburban area consisting of many communities and neighborhoods. From twenty-five to fifty or more different retail outlets typically comprise the suburban center.

When the uncontrolled suburban or outlying central city center serves over 100,000 people, it begins to assume in miniature the retail structure of larger cities. It tends to develop its own "downtown" district and the resultant parking and traffic problems. When this occurs, the suburban center loses some of its attraction as a site for additional expansion, particularly by department stores.

d. The regional center services a trading area of from 100,000 to 1,000,000 or more people. In addition to convenience and specialty goods stores, it contains at least one department store branch. Usually the branch has between 100,000 and 300,000 square feet of selling space. A full line of shopping and specialty goods is featured in the center. Regional centers are in effect decentralized substitutes for the downtown center featuring forty to one hundred or more stores on a site of at least fifty acres.

Centers Are Postwar Outgrowth

The controlled center is largely a post World War II development, though isolated controlled neighborhood and community centers were in operation as early as the 1920's. Various estimates place the number of controlled centers at probably between 2,000 and 3,000 controlled shopping centers of all four types, completed or in advanced planning or construction stages. Only six regional centers were in operation as of January, 1955.

The reasons for the emergence of large controlled centers have been discussed by Duncan and Phillips (3), Brown and Davidson (4), and others. There is agreement that the centers evolved to meet the needs generated by changing environmental factors in the economy. These factors include increasing urban population decentralization, increased use of the automobile, increased congestion in central busi-

ness districts, the lack of economical and convenient parking facilities in downtown areas, and changing consumer buying habits. The important point is that these forces and others favoring retail recentralization seem to be increasing rather than diminishing.

A population of 221,000,000 by 1975 has been predicted. The increase in population alone will be enough to support dozens of large new shopping facilities. In addition, higher living standards brought about by automation and rising productivity, increased leisure time, and a rising educational level, all seem to favor further population decentralization and retail recentralization in large shopping centers.

Other forces, such as an increasing national income, are also likely to result in a response by entrepreneurs of more and better decentralized shopping facilities. It may well be the controlled shopping center movement is in its infancy. Of course, a saturation point for shopping centers can be reached. And merchants in shopping centers can fail. For location is still only one ingredient of a successful retailing operation. Many other questions of planning, financing, and operation must be answered before a center is assured of success.

Locating Regional Centers

The ideal regional center site is the one from which the largest number of automotive customers in a trade area can be served at the minimum of transfer costs. Consumers' transfer costs include not only money costs but the expenditure of time and physical and nervous energy that must be made to purchase goods. The reason controlled regional shopping center sites are preferred close to the center of the suburban population areas is that consumers' transfer costs are usually minimized at such sites.[3] In locating market-oriented facilities, the ideal is to choose a site as close as possible to the scarcest factor and the one having limited mobility—the customer.

It is believed the choice of a site at which transfer costs will be minimized for the largest number of automotive customers will be

[3] In economic theory the reason why sites at the center of urban activity are considered most desirable is found in the labor savings involved in a central location. This valuation is reflected in the form of higher rents.

facilitated by using the following factors as criteria of site selection.[4] The factors are classified as either regional or site factors. Regional factors are those of population, purchasing power, growth, and competition. The site factors are access, traffic, size, expansion, parking, cost, terrain, and utilities.

Regional Factors

Population: Regional centers are best located in concentrated residential populations in outlying sections of large metropolitan areas. Ordinarily a minimum of 500,000 people should reside within thirty minutes' driving time distance of the site.

Purchasing power: Regional centers should be located in an area only after an analysis of the purchasing power and stability of income and expenditures of residents indicates the trade area is sufficient to support a regional center of the size contemplated.

Growth: The section of most rapid population growth and probable future expansion within the metropolitan area is normally the most promising sectional choice for a suitable regional center site.

Competition: The location of competition as it affects potential sites should be investigated both quantitatively and qualitatively. A regional center should be located in an area only when proof exists that operating and planned retail facilities are inadequate.

Site factors

Access: A regional center site should be easily accessible to automotive traffic. The site should be in a prominent location and be served by a system of primary and secondary roads, offering convenient, safe, and free flowing means of access and egress.

Traffic: Sufficient road capacity should be available to handle existing traffic around the site, traffic likely to be produced by future expansion in the area, and traffic created by the additional vehicular activity the center will generate.

[4] The criteria were prepared during a study of the processes used in locating the following regional centers: Shoppers' World, Framingham, Massachusetts; Cross County, Yonkers, New York; Roosevelt Field, Hempstead, New York; Garden State Plaza, Paramus, New Jersey; Bergen Mall, Paramus, New Jersey; and Northland, Detroit, Michigan. The writer is grateful for the cooperation of the developers and managers of these centers.

Size: The site should be large enough to provide the desired amount of store and service facilities, and parking at a parking-space to floor-space ratio of at least three to one and preferably, four to one. Sufficient land should be acquired to serve as a buffer and possible expansion area. With regional centers these specifications usually require a minimum site of fifty acres.

Expansion: Provision should be made in the earliest planning stages for expansion after the center is established. The developers should attempt to build with expansion provisions for five and ten year periods ahead. Excess space can be used for landscaping and recreational purposes until needed for commercial use.

Provision for expansion may be necessary to hold a planned position in the event of an increase in population and trade after the center opens. If the center can not expand as needed, other shopping facilities will develop in the area pioneered by the first center.

Parking: The tract should be of a size and shape to provide parking in at least a three-to-one ratio of parking to store space. Shoppers should not have to walk more than four hundred feet from their automobiles to the nearest store. The ideal ratio of parking to store space increases with the size of the center.

Site cost: The cost of acquiring the site, preparing it for construction, and any extraordinary maintenance costs must be carefully measured and considered. In general, land costs are not to be economized upon at the expense of losing a premium site.

Terrain: The terrain should be thoroughly examined by architects and engineers in advance of purchase to ascertain conditions which might affect the locational decision. In general, level ground and solid earth represent the preferred terrain conditions.

Utilities: Utilities should be available to the site at the time of acquisition or at completion of the center. Regional centers will ordinarily maintain some of their own utility services, but power, water, and sewage facilities should be available to the property line.

These factors have been incorporated in the following site-ranking chart. The ranking chart assumes the availability of the rated site, together with its possibility of rezoning. The ideal site might be unavailable. In such a case, the next most promising site on the market should be rated. Similarly, rated sites should be zoned or rezonable for shopping center development. It is self-evident that a

developer should not go too far in his planning about a particular site unless he has reason to believe the site is available commercially and legally.

The site-ranking chart is designed to serve only as a general guide in deciding on the site selection. It is recognized that an entrepreneur choosing sites might find it difficult, if not impossible, to focus on a particular site all of the information that might be relevant. Yet, the use of a site-ranking chart should produce more valid site ratings. Table II.

Controlled Centers and Central Business Districts

It appears probable that population and transportational forces responsible for the increase in regional centers after World War II will continue unabated for at least the next few years. But the central business district will continue to dominate retail trade in most metropolitan areas, although the proportion of business done by suburban centers will increase. Suburban volume will increase because of suburban residents' dissatisfaction with existing retail facilities in the major central business districts.

The chief complaint is transportational. It is a wearisome chore for suburban shoppers to overcome the friction of space and reach most central business districts through congested traffic and crowded streets. On reaching the central business district, finding a convenient parking space is typically a problem. Public transportation is available, but it can do only part of the job in a culture wedded to the private automobile.

Some evidence exists that central business district retailers are becoming concerned enough about suburban competition to take action to increase downtown trade. In some instances merchants are cooperating to obtain improved transportational and parking facilities for central business districts. Their cause is hopeful. There is no reason why central business districts served by efficient highways bringing suburbanites to the city and to the downtown areas, perhaps on expressways, and to adequate parking facilities, should not be able to compete successfully with regional centers.

But even with the adoption of every type of palliative advanced, it appears the factor of population increase and migration alone is

Table II

CONTROLLED REGIONAL SHOPPING CENTER SITE RANKING CHART

Description of Site Being Rated_____

Factor being rated	*Ranking of site* (in order of relative preference)				
REGIONAL FACTORS	1	2	3	4	5
Population					
within 15 minutes					
16–30 minutes					
Purchasing power					
amount and stability					
distribution					
Growth of population					
amount					
degree					
Competition					
amount					
quality					
SITE FACTORS					
Size of tract					
minimum size					
undivided					
buffer area					
Access and egress					
primary roads					
secondary roads					
Traffic					
present pattern					
future pattern					
Parking					
amount					
nearness to stores					
Cost					
acquisition					
maintenance					
Terrain conditions					
grading					
subsoil conditions					
Utilities					
proximity					
Expansion-Environment					
expansion					
environment					

enough to favor the creation of more recentralized retail facilities in the hinterland.

In both theory and fact central business districts have attractions that will insure their continued importance as centers for commercial and recreational life of metropolitan areas. But they will encounter more competition from other elements in the retail structure. However, the central district has a natural locational advantage of being the point which the greatest number of people in the metropolitan area can reach most economically. This advantage ordinarily should suffice to assure its dominant position.

NOTES

1. Samuel C. McMillan, "Decentralization of Retail Trade," *Traffic Quarterly,* April, 1954.

2. "The Lush New Suburban Market," *Fortune,* November, 1953, p. 128.

3. Delbert J. Duncan and Charles F. Phillips, *Retailing Principles and Methods,* Chicago, Richard D. Irwin, Inc., 1955, 4th ed., p. 79, 82.

4. P. L. Brown and W. P. Davidson, *Retailing Principles and Practices,* New York, Ronald Press, 1953, p. 75.

5. Arthur M. Weimer and Homer Hoyt, *Principles of Urban Real Estate,* New York, Ronald Press, 1948, p. 138.

6. U. S. Department of Commerce, *Intra-City Business Census Statistics of Philadelphia, Pennsylvania,* Washington, Bureau of the Census, 1937, p. 25.

7. Amos H. Hawley, *Human Ecology,* New York, Ronald Press, 1950, p. 270. The influence of metropolitan centers was also examined by Donald J. Bogue, *The Structure of the Metropolitan Community: A Study of Dominance and Subdominance,* Ann Arbor, University of Michigan Press, 1949.

8. Ernest M. Fisher and Robert M. Fisher, *Urban Real Estate,* New York, Henry Holt and Company, 1954, p. 317.

More Flexibility Is Needed in Traffic Control

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A FRIEND recently came into my office, most indignant because he had been arrested for speeding. He was charged with driving 36 miles per hour in a 30 miles per hour speed zone. On the surface he had little to be indignant about. He had been exceeding the speed limit by six miles per hour, which was certainly a traffic violation. The fact was, however, that my friend was not traveling as fast at the time of his arrest as the majority of traffic usually moves even during the heaviest traffic periods on that particular artery—and he knew that. His arrest occurred at an off-peak period, when traffic was light and a driver exceeding the speed limit could be singled out easily. Apparently no factor of reckless driving was involved. He was arrested for driving no faster than most motorists drive there under even more hazardous and congested traffic conditions.

This is not the first case of its kind to come to our attention. Even in my own driving, when simply trying to keep pace with other vehicles, I am at times aware of traveling at speeds in excess of the speed limit. I have always endeavored to be a safe driver and a law-abiding citizen—but in such cases I found myself a law violator. Yet I felt I had done no wrong.

These and other failures of our traffic controls prompted me to

ask my associate, J. Edward Johnston, to gather some facts. The matter of most interest was the tendency to establish unreasonable speed limits in many parts of the country. But I was also interested in data on any traffic regulation or device which did not seem to accomplish the purpose for which it was intended.

To gather these facts, prominent traffic officials in many parts of the country were queried. We are indebted to these persons for sending in data.

Unreasonable Speed Limits

One of the first case histories studied was a tabulated summary of speed checks received from a city of 75,000 people in New York State covering ten locations on its primary streets. The following table presents significant facts.

SUMMARY OF SPEED CHECKS

A City of About 75,000 Population in New York State

Location Identification Number (As shown on summary received)	Maximum Speed at Which 85% of Cars Traveled	Percent of Drivers Exceeding 35 M.P.H. Speed Limit
11	50.0	84
12	49.0	82
13	45.0	57
14	49.0	80
15	49.0	92
16	45.0	79
17	49.0	93
18	48.0	92
19	45.5	78
20	46.5	67

Note that from 57 to 93 percent of the drivers were exceeding the speed limit. In eight out of the ten cases, over 75 percent were exceeding the speed limit. Does this mean that the vast majority of drivers using these streets are unmindful of the need for cautious driving and traffic safety? I can't believe that it does. To me, these facts indicate a poor job of establishing speed limits; they reveal a failure to recognize the fact that most motorists drive with reasonable safety.

But what should be the speed limit in such cases? The summary shows the "85 percentile." This is the speed exceeded by only 15 percent of the drivers. It is a measure of speed generally used as a guide in establishing proper speed limits. If the limits for the streets cited were determined by this system, instead of the 35 MPH now in effect, a 45 MPH limit would be used in four of the locations and a 50 MPH at the other six locations. Other factors might be found in a speed zoning study to justify some modification of such limits, but the 85 percentile evidence would be very persuasive as to the justifiability of substantially higher speed limits.

A speed survey report from Minnesota shows a similar experience. The study involved a heavily traveled belt highway. The speed limit was reduced from 50 to 40 miles per hour because of public pressure. After the speed limit was lowered, from 51 to 72 percent of the drivers were exceeding the speed limit and from 22 to 35 percent were traveling five miles per hour or more over the limit. Many drivers believe that the police will allow a five MPH tolerance before making an arrest. In the Minnesota case, at least one out of every four drivers would be subject to arrest even with this tolerance. Were those 22 to 35 percent indifferent as to safety? I do not believe that is a reasonable assumption.

Some people contend that the speed limit must be considerably lower than the speed actually permitted without arrest because of the tendency on the part of drivers to exceed any posted limit. *A study in Nebraska suggests that motorists drive at what they feel is the safe speed, even though the speed limit would permit them to travel faster.* On a four-lane section of divided highway posted for 60 MPH (state speed limit), a speed study showed that 85 percent of the drivers were traveling 51 miles per hour or less. The speed limit was subsequently lowered to conform to this 85 percentile. A speed study made after the change in limit showed that there was no change in vehicle speeds. In other words, the speed limit there was not the controlling factor in driving speeds—rather it was the drivers' own appraisals of conditions. "Blanket" speed limits cannot possibly fit all conditions properly. Most motorists normally do not drive faster than they believe conditions warrant even though the speed limit permits them to do so. Speed limits should conform in a large measure to the way the 85 percentile of drivers travel.

Economic Loss through Too Low Speed Limits

Unreasonable speed limits penalize drivers in more ways than by making them subject to arrest. For example take the case cited for Minnesota. When the speed limit was reduced from 50 to 40 MPH. the average speed was lowered from 47 to 43.5 miles per hour. Assuming an average daily traffic flow of 10,000 vehicles and that the length of the road involved was 10 miles, drivers would lose 166 hours daily in driving time, or 2,524 vehicle-days per year. Conservative estimates have placed a value on time for passenger cars at 1½ cents per minute. Using this figure, the economic loss on this section of road due to vehicle delay would amount to approximately $55,000 annually. This economic loss in delay might be warranted if the lower speed limit reduced accidents. The report is, it did not.

Some states have speed laws which actually prevent the establishment of reasonable speed limits. For example, in Texas prior to 1951, the state law specified a 30 MPH speed limit through incorporated and unincorporated cities and towns. The law gave local incorporated municipalities the authority to raise or lower the limit on the basis of a traffic engineering study. It made no provision for doing so in *unincorporated* towns. As a result, the 30 MPH speed limit prevailed in these unincorporated towns regardless of conditions. The law has since been changed so that the unincorporated towns now have proper speed limits based on traffic studies.

In the Nebraska speed study, where no change occurred in the actual speed pattern despite a reduction of speed limit, it was reported that during comparable "before" and "after" periods, the accident rate was reduced 15 percent and the injury rate 36 percent. How can this result be accounted for when there were no changes in the speeds? It apparently was attributable to an intensive safety program which made motorists more aware of the need for caution on this stretch of highway. They didn't drive more slowly, but they were more alert or cautious.

Some Questions about Speed and Speeding

Rapid movement with reasonable safety is the goal in transportation. This is evidenced by the rapid strides in air travel. Since fatal-

ities occur at almost all rates of movement, when does the rate become "speed that kills," and incompatible with sound transportation? Until this question has been satisfactorily answered, we should not be too dogmatic as to a specific speed limit. Should not more emphasis be directed toward "failure to yield right-of-way," "following too closely," "on wrong side of road," "disregarding traffic control signals," "driving while under the influence of an intoxicant"?

Have speed limits been established to make it easy for the police to make arrests rather than to provide safeguards to highway users? Should speed limits make normally careful drivers into frequent law violators?

Basic Rule Governs all Speed Regulation

Regulation of speed is a difficult task. However, all speed laws depend fundamentally on a basic rule—driving at a speed which is reasonable and prudent in light of existing conditions. Actually, for his own protection if for no other reason, this is one rule which every sane driver intends voluntarily to observe—and if the judgments of all drivers were at all times correct, this would be the only speed rule needed. Indeed it *is* the only rural speed law applying to passenger cars in some seven states. Those states have no rural, numerical speed limit for passenger cars.

Absolute versus Prima Facie Speed Limits

There is no numerical speed limit that properly fits every foot of street or highway all of the time, and for all drivers, and all cars. Yet some states and cities use "absolute" speed limits—that is, fixed numerical limits which it is a violation to exceed in any circumstances. And a rather strong effort is made in many places to get speed limits changed to absolute limits. The tendency is to interpret such laws as meaning "as long as you don't go over this limit, you are driving safely." But there are times when such a limit is too fast and other times when faster speeds might not be hazardous. With absolute speed limits, the violator is guilty if it can be proved that he was exceeding the posted limit. It makes no difference that a slightly faster speed was safe and reasonable under the circumstances.

In other words, the motorist is subject to arrest and conviction without regard for the actual danger which may or may not exist. Little attention is paid to the basic rule where absolute (fixed) limits are used. Yet it is clearly impossible to set forth any absolute limit which will be reasonable and safe under all conditions.

If some type of numerical speed limit must be used, then it should be "prima facie."[1] Twenty-six states have prima facie limits. Prima facie limits have the *flexibility* necessary to permit taking account of varying conditions. Although they indicate what maximum speed is considered broadly desirable, motorists are not confined to this limit under less hazardous conditions, nor are they entitled to this speed if driving conditions do not warrant it. *This type of limit permits the courts to decide the case according to the existing conditions and factors.*

It is easier to convict a motorist of speeding when the only proof needed is exceeding some numerical speed limit. Admittedly, the court faces a more difficult decision when a motorist, accepting the burden of proof as required when he exceeds a numerical prima facie limit, seeks to prove that nonetheless he was not violating the basic rule requiring a reasonable and prudent speed, taking due account of conditions.

It is more difficult to understand why police dislike prima facie limits, for the burden of proof in all arrests for exceeding the prima facie limit falls on the driver, *not on the police officer.* It is only in case of arrest at a speed *below* the prima facie limit that the burden of proof is upon the police officer, to convince the court that though the motorist was not exceeding the speed limit he was nonetheless violating the basic rule because of unfavorable factors then existing. Such an arrest would only be made if conditions were obviously quite unfavorable, so the arresting officer should have a good case to present to the court.

Thus it would appear, since much objection to prima facie limits

[1] "Prima facie" means literally "on the face of it." A prima facie speed limit is based on a numerical limit, but it differs from the absolute speed limit in this very important respect: To exceed a prima facie speed limit is *not* conclusive or absolute evidence of a traffic violation. If a prima facie limit is exceeded, the burden of proof is on the driver to show that in the circumstances it was reasonable and prudent for him to have done so. Also, an enforcement official can arrest a driver, under a prima facie limit, even though the driver was driving *below* the posted limit. But in that situation the enforcement official has the burden of showing that in the circumstances the speed of the driver was not reasonable and prudent.

comes from police, to be a case of the police not being properly informed, or instructed, or trained. Indeed, it seems to me that the trouble *must* lie greatly in that area. For proper understanding would surely cause police to *work for* prima facie limits with their greater equity and safety potential.

Some say the main reason they oppose prima facie limits is that the public does not understand them. The inference must be that such lack of understanding is disadvantageous.

Let us examine this point. Suppose a driver does *not* understand the meaning of *prima facie* as applied to a speed limit. What will that driver think the speed limit does mean? Isn't he most likely to think that it is the top speed permitted? I believe so. In such case, will not the motorist be likely to obey the limit as though it were a fixed or absolute limit? I think so. The result then would be that such a motorist would not realize that under especially favorable conditions, speeds somewhat higher than the numerical limit stated could be proved to be still "legal."

Those opposed to a prima facie limit because of the lack of public understanding, are generally concerned about drivers going too fast. It would seem that any such lack of understanding would *reduce* the tendency to drive somewhat above a numerical prima facie limit under especially favorable conditions. Therefore, their reasoning seems incorrect.

It was pointed out that prima facie limits do make court adjudication more of a task. Is such added court work warranted? We say it very definitely is warranted. It is the only way to assure that justice will be done. For proper adjudication of prima facie limits *puts the emphasis where it should be placed—on the facts, factors, and conditions existing, and on whether the basic rule was broken—whether at a speed above or below the prima facie limit.* Better public support will result when the people recognize that the facts of the situation are given proper consideration.

If there is need to see that courts understand the true significance and potential value of prima facie limits, *that is where the necessary work should be done—instead of seeking to change a more equitable type of law for one which can be enforced more easily.*

Speed enforcement should be directed at speed "too fast for conditions." No absolute, fixed limit can produce that result at all

times and under all conditions. Few laws are obeyed simply because they are laws. They must be regarded as *reasonable* by the majority. Because of widely varying roadway and traffic conditions, absolute or fixed limits are not reasonable much of the time. Many more motorists sense this than the advocates of fixed speed limits apparently realize. The result is loss of some degree of respect for the speed law, and this is probably a factor in the very extensive degree in many places of non-observance of such speed limits.

Enforcement Opinions Versus Facts

A recent newspaper clipping from one state credited a radar patrol with "slowing drivers." It claimed that the success of the radar campaign could be seen in a comparison of figures for the last half of 1953 and 1954: "The police hauled in one-third more speeders and are confident six months of patroling the highways with the new radar device has cut down speeding . . . it has improved behavior of the motorists."

If the interpretation of the effects of enforcement is based on opinion, it is on shaky ground. We too often see only what we want to see. If we think traffic is too fast, we notice mainly the fast-moving vehicles. If we are looking for the effects of speed enforcement, we note the slower vehicles and are surprised at how many there are. In either case, we don't see the over-all picture in its true perspective. Effects should be measured by facts—not opinion. In the case just referred to where radar was used, would a "before and after" speed study show that hitherto excessive speeds had been substantially lowered? If so, then the value of the enforcement program would be demonstrated. If not, opinion should not be allowed to govern, and the enforcement program should be reappraised and revised.

To the maximum extent feasible, enforcement should be directed against the small minority of total driving which is seriously hazardous. Given reasonable laws and regulations and the proper "atmosphere" in which to drive, most motorists will drive at reasonable speeds and obey traffic regulations almost all of the time. Any tendency toward a motorist-persecution complex should be *carefully* avoided!

In one city, a few high school students were making raceways out of the city streets with their hot rods. Rather than find out who these students were and approach the problem as individual cases, the city officials proceeded to install numerous four-way stop signs throughout the city, and in some cases went so far as to put stop signs on the arterial streets, making the minor cross streets the throughways. The idea apparently was that if these speeders had to stop often enough, they couldn't get up much speed. But just think of what such a plan did to the thousands of good drivers using the city streets daily. Certainly hours and hours of unnecessary vehicle delay resulted. Worst of all, the plan did not solve the problem or reach the heart of the difficulty. This could only be done by reaching the transgressors individually.

Unwarranted Traffic Control Signals

Traffic stop-and-go signals also need closer examination as to their design and application. Stop-and-go signals are regarded by many as the solution to traffic accidents at intersections. Signals may reduce accidents if properly applied, but if they are not properly applied they may do more harm than good.

As an example: traffic signals were installed to replace stop signs on an important Virginia highway at its intersection with a city route. According to the "Manual on Uniform Traffic Control Devices," the signals were not warranted. (This Manual is the guide used by most traffic authorities throughout the nation in the determination of the warrant, design, installation and operation of traffic signs, signals and markings.) Three times as many accidents occurred during fifteen months "after" the signals were installed as during seventeen months "before":

	"Before" Study Jan. 1, 1950 May 31, 1951	"After" Study May 31, 1951 Aug. 31, 1952
Total number accidents	6	19
Number injured	1	4
Number killed	1	0
Property damage	$1,670	$11,105

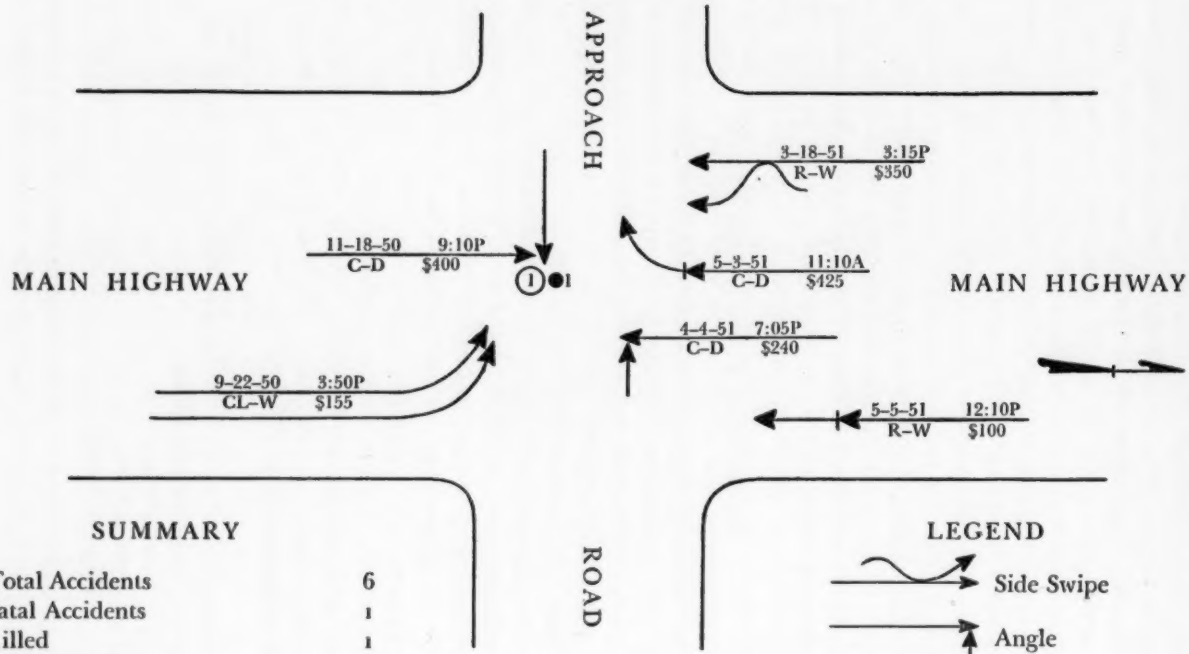
It can be seen from the collision diagrams that the signals increased rear-end collisions and did not reduce the number of accidents of a

COLLISION DIAGRAM

Before Study

JAN. 1, 1950–MAY 31, 1951

(17 Months Study *Before* Installation Traffic Signal)



SUMMARY

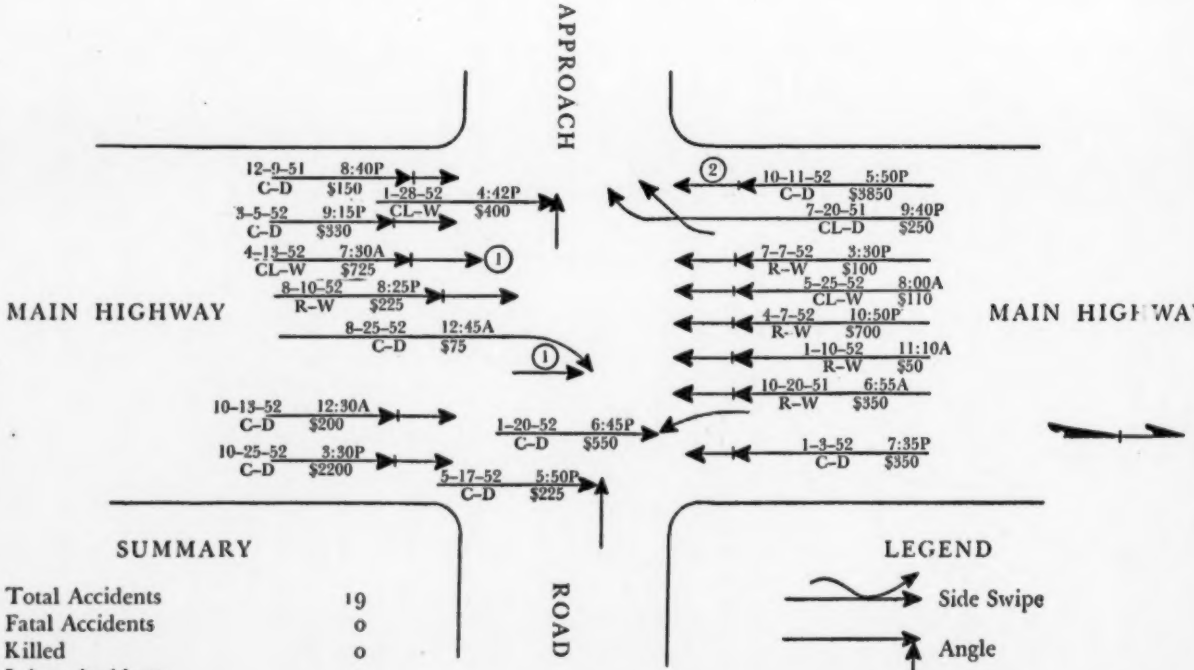
Total Accidents	6
Fatal Accidents	1
Killed	1
Injury Accidents	0
Injured	1
Property Damage Accidents	5
Amount Property Damage	$1,670
Vehicles Involved	12

COLLISION DIAGRAM

After Study

MAY 31, 1951—AUG. 31, 1952

(17 Months Study *After* Installation Traffic Signal)



SUMMARY

Total Accidents	19
Fatal Accidents	0
Killed	0
Injury Accidents	3
Injured	4
Property Damage Accidents	16
Amount Property Damage	$11,105
Vehicles Involved	41

LEGEND

Side Swipe

Angle

Rear End

Injury

cross-traffic type. Signals, *where warranted,* reduced cross-traffic accidents. It may be concluded that these traffic signals were a contributing factor in 13 accidents, 4 injuries and $9,610 in property damage.

A similar situation was reported in a midwest state. At a location where an unwarranted signal had been installed, 11 accidents were reported during a 12-month period. After its replacement by two-way stop signs, only one minor accident was reported during a comparable period. The use of stop signs at this location not only reduced accidents but resulted in only one-sixth as much delay due to the traffic control device.

Other Traffic Signal Problems

The traffic signal problem is not confined to one of warrants for installation. There is a great need for uniformity in the design and location, and improvements in signal timing. Our crossroads are covered with widely differing types of traffic signal, mounted in many different ways. Red lights are still sometimes found on the bottom with green lights on top. Some signals have "intersection clearance" lights that are red instead of yellow, and some have no clearance lights at all.

Some signal lenses are bright and clean, but far too many are so dirty as to greatly reduce the effectiveness of the signal. Many signals are poorly timed. Signals are located near-right, far-left; far-right, near-left; near-right, near-left; etc. They are mounted on pedestals, affixed to utility poles, suspended on cables and extended on mast arms. They are placed amid backgrounds of neon signs, street lights, trees and poles. "Give us prominently located signals we can easily see!" cries the motorist.

How many times have you waited at a signalized intersection for the light to change when there was no traffic on the cross street and nothing moving in the intersection? It is difficult to adapt fixed-time signals to fit the varying traffic demands of the day. Yet much more could be done to overcome this problem by using "program" timers that change the signal operation, often several times daily, to meet changing traffic needs, and by using more vehicle-actuated signals.

A traffic signal case study in an eastern city would be of interest at this point. Up until a year ago the signal at this intersection was a fixed-time type of controller that provided a left turn interval. The controller was changed to a volume-density, three-phase, vehicle-actuated type. This is the most flexible type of signal controller on the market today. It varies the length of time given for the "go" period in each cycle according to the continual fluctuation in traffic demand. When the signal controller was installed, the signal pedestals were better located and the order in which the different signal indications appeared was rearranged. Although these changes were more for the purpose of reducing congestion and delay, they also substantially reduced traffic accidents.

The changes were made in February, 1954. During the year prior to the changes there were twenty accidents involving six personal injuries. From February to the end of December, 1954—only one month less than a year—only seven traffic accidents were reported, with three personal injuries. The interesting fact was that before, ten of the accidents were "right angle," the principal type which stop-and-go signals should prevent, while after, none of the accidents were of this type.

Another report from a southern state cites a case in which a fixed-time traffic signal had been installed on a main, heavily traveled highway because of a school crossing. This might not have been too bad, but the signal operated on a 50-second cycle both day and night, despite the fact that there was little vehicular cross traffic. As reported, this resulted in "considerable unnecessary delay throughout the day and night to heavy highway traffic." A semi-actuated control with pedestrian push buttons was recommended.

Too often, traffic signals have been installed because of an uninformed public demand. Many intersections are dotted with traffic signal memorials for those who have been killed in traffic accidents even though a study of the facts often proves that such signals would not have prevented the fatal accident—and increased numbers of serious accidents have resulted after the signals were installed.

Traffic signals serve a useful purpose if installed where warranted and in accordance with the approved design standards. But

there are many unwarranted, poorly designed signal installations. What price is the public paying in traffic accidents and delay because of this deplorable situation? If we knew, I'm sure we would be amazed at the amount.

Traffic Markings and Signs

Too often our traffic administrators fail to take account of roadway usage in painting lane lines. In some places in cities, motorists drive three abreast although the street is marked for two lanes. There are locations with no lane marking where motorists drive in two lanes but would move in three lanes and thus greatly increase street capacity *if the street were properly marked.*

Could not traffic conditions at many intersections be improved by using the "yield-right-of-way" sign?[2] I am thinking of instances where traffic backs up for blocks during rush periods because of the required stopping of each vehicle at a stop sign, but where there is a long sight distance in both directions. If a "yield-right-of-way" sign were used, many of these drivers would not need to come to a full stop because they could see that no cross traffic was coming close-by from either direction, and much of the delay could be avoided.

The "yield-right-of-way" sign was recently approved by the National Joint Committee on Uniform Traffic Control Devices. Some legal questions have been raised as to this type of regulation, and these are being studied. Nevertheless, the idea is being used, it is reported, in more than 100 cities and some fifteen states. Portland, Oregon, reported a 30 percent reduction in traffic accidents for fourteen locations during a six-months' period after these signs were installed in comparison to a comparable "before" period.

Some of the cities using this new sign and reporting favorably on it are: Oklahoma City, Oklahoma; Dallas, Texas, Lincoln, Nebraska; Tulsa, Oklahoma; Providence, Rhode Island, and Cincinnati, Ohio. Some states using this sign are Illinois, Colorado, Maine and Virginia.

2 Drivers approaching a yield-right-of-way sign must always yield the right of way to other traffic in the intersection or approaching so close to it that failure to yield right-of-way would be hazardous. However, it is NOT necessary to come to a full stop at such a sign if no traffic would be endangered or interfered with by proceeding slowly and cautiously. In case of any accident, the presumption would be that the driver who passed such a sign was at fault.

Conclusion

The purpose of all traffic regulations and control should be to move traffic as rapidly and safely as possible with the minimum of restriction to the motorist and the public. All traffic regulations and control should justify themselves under these criteria. Unfortunately all do not. I am not unmindful or unappreciative of the many that do. But there is room for much improvement. These improvements will come only as we take a more realistic view of highway transportation and pattern our efforts on the proved standards available for the purpose. Good laws and proper use of traffic control devices are attainable. Tried and proved guides are set forth in the recently revised "Uniform Vehicle Code" and the "Manual on Uniform Traffic Control Devices for Streets and Highways." Also available are excellent patterns for improving enforcement, as through the Northwestern University Traffic Institute.

We cannot afford to waste time in unnecessary traffic delay. With the millions of vehicles on our streets and highways, wasted moments soon snowball into hours, hours into days—days of delay that cannot be retrieved and represent millions of dollars of loss annually to motorists. Too many traffic officials are insufficiently concerned about the few moments of unnecessary waiting here, and the few moments of delay there.

Traffic control must not be static, but rather dynamic. Traffic regulations and devices should be as flexible as possible to adapt themselves to the dynamics of the motor age in which we are living. Speed limits should be prima facie limits which provide some flexibility and call for attention to existing conditions.

Traffic signals should be, as nearly as is feasible and economically justifiable, suited to varying traffic demands. Stop signs should be used sparingly, and many unwarranted stop signs could well be replaced by the new "yield-right-of-way" sign. We need new understanding as to speed. Speed is the essence of transportation and unreasonable speed curtailment reduces the maximum efficiency we seek in transportation mobility. Undue emphasis has often been placed on violation of an arbitrary, inflexible speed limit instead of on "too fast for conditions" and on often accompanying dangerous practices such as "improper overtaking and passing," on "wrong side

of road," and "following too closely." Really serious violations should be dealt with vigorously, but every effort should be made to avoid unreasonably penalizing the very high percentage of good driving. *Most drivers are good drivers most of the time.* Let us study more carefully what they are doing and make a greater effort to adjust traffic control devices to fit their needs.

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